DEVELOPMENT AND ANALYSIS OF A
DUAL-ROLE FIGHTER DEPLOYMENT FOOTPRINT
LOGISTICS PLANNING EQUATION

THESIS

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Abstract

This research investigated the deployment footprint of a developing dual-role fighter, the Joint Strike Fighter (JSF). This thesis documents the creation of a point estimate linear equation and a spreadsheet model for deployment footprint analysis and provides three example applications of the spreadsheet model for the JSF. The development of the model focused towards direct application in the JSF acquisition process, however, this research also serves as a proof of concept for modeling any future weapon system's deployment footprint. The developed spreadsheet model allows the model manipulator to select a baseline weapon system then alter the various components which make up the overall footprint. The result is a point estimate of the total footprint which can then be used in justification during trade-off studies. The model was developed using Microsoft Excel 5.0 and a synopsis of the model procedures is included at Appendix I. If disk copies of the model are requested from the authors, the package will also include a users manual which is not part of this thesis.

DEVELOPMENT AND ANALYSIS OF A DUAL-ROLE FIGHTER DEPLOYMENT FOOTPRINT LOGISTICS PLANNING EQUATION

I. Introduction

General Issue

The requirement to deploy combat forces around the globe drives the need for academic research into the sizing of a deployment package (hereafter referred to as the "footprint") as it relates to new weapon system development. The Joint Strike Fighter (JSF) Program Office is specifically interested in developing a model of the deployment footprint for the next-generation dual-role fighter, the JSF.

Joint Strike Fighter Program

The JSF is an aircraft weapon system presently in the early stages of its development cycle. The JSF is a multi-service, multi-national effort focusing on the development, testing, and fielding of a replacement aircraft for aging air-to-ground fighter aircraft such as the Air Force's F-16 and the Marine Corps' AV-8 Harrier. The JSF program is currently in the Program Definition and Risk Reduction phase of the acquisition process. The focus in this phase is on defining the roles and functions of the aircraft and upon selection and integration of design and technology advances into this future weapon system. This research provides a deployment footprint model to the JSF

and analyzes the effects of design and technology advances on the deployment footprint of this developing weapon system.

Key Concepts

Understanding the dual-role fighter deployment footprint issue fully requires at least a cursory understanding of the overall acquisition process, as well as the concept of the Unit Type Code (UTC).

<u>The Systems Acquisition Process</u>. The Department of Defense (DoD) Systems Acquisition Process is divided into four distinct phases; Phase 0, Concept Exploration; Phase I, Program Definition & Risk Reduction; Phase II, Engineering and Manufacturing Development; Phase III, Production, Fielding/Development, and Operational Support. The purpose of each of the phases is discussed here to allow the reader to better understand the context of this research.

During Phase 0, Concept Exploration, the acquiring organization administers competitive, parallel short-term concept studies designed to define and evaluate the feasibility of alternative design concepts. Another objective of this phase is to determine if a new acquisition program is needed.

Phase I, Program Definition & Risk Reduction, is the program phase when action is taken to reduce risk of incorporating new and emerging technologies into the developing weapon system. The program goal is to better define the system's characteristics and capabilities and identify preferred design approaches. Additionally,

affordability, operational suitability and effectiveness, program risk and stability issues are addressed at this time.

In Phase II, Engineering and Manufacturing Development, the goals are to finalize system design and make it ready for production. During this phase, both developmental and operational testing are performed. The weapon system's configuration and production baseline are established during Phase II and, if Low Rate Initial Production is planned, it will be during this phase.

The last systems acquisition phase is Phase III, Production, Fielding/ Development, & Operational Support. Here the program establishes a stable, efficient production and support base while achieving an operational capability to meet the user's needs. Phase III also encompasses any modifications necessary to maintain the weapon system, as well as the ultimate system disposal.

Unit Type Code (UTC). The UTC is the building block for the Department of Defense deployment system. A UTC is a five-digit code made up of numbers and letters and represents the combination of people and/or equipment necessary to provide a certain capability. This capability is described in the UTC's Mission Capability Statement and can vary tremendously. This study focuses on two types of UTCs; Aviation UTCs which generally start with a 3 as their first character, and Intermediate Level Maintenance UTCs which start as either HF, or HE. UTCs are the means of tasking a unit to maintain and deploy a certain capability and are an integral part of the military command and control system. Appendix C shows an example of the cargo portion of an Aviation UTC, 3FATA, an 18-aircraft F-117A aviation deployment package.

Background

Global Reach, Global Power. Changing world events over the past five years have caused the U. S. military to dramatically change its mode of operations. Before the downfall of the Soviet Union, the United States military projected its power through a policy of forward presence. Military bases spread around the world served notice that America was committed to maintaining a stable world order. As the Soviet Union has disintegrated, the need to maintain our foreign presence has presumably decreased. Starting in 1990, the U. S. Air Force adopted the goal of "Global Reach, Global Power" (Rice, 1990). In response to this changing policy, then-U. S. Air Force Chief of Staff General Larry D. Welch stressed the importance of flexible forces, able to rapidly deploy around the world with minimal support and minimal re-supply (Canan, 1990). The hard reality is that the *modus operandi* the U. S. military has relied upon for planning and operated under for decades had changed. Complicating that fact is that in addition to a changing mode of operations, the very nature of the operations themselves has evolved (Natsios, 1995).

Changing Nature of Operations. Lately the United States military has been tasked to perform roles previously thought to be non-military (Lempert, 1993). As illustrated in Barber's writings on the future of the U. S. military, the U. S. military and its people can expect more "operations other than war" (OOTW) in the future. Examples of OOTW are: regional deterrence, stability, and humanitarian assistance (HA) (Barber, 1994; Lempert, 1993). Operations such as those in Somalia in 1992, Ruwanda in 1994,

PROVIDE COMFORT in Northern Iraq in 1990, and PROVIDE PROMISE in Bosnia in 1993 will continue to draw the attention and resources of the U. S. military (Kassing, 1992). Natsios, in his *Parameters* article "The International Humanitarian Response System" states that from 1978-1985, an average of five significant relief operations were conducted per year (Natsios, 1995). By 1993, that number had risen to 20 per year with the changing world order thought to be responsible for some of the changes. Research by Smith and Stansfield in the area of HA has modeled the steps associated with these kinds of HA efforts, and lays the groundwork for quantitative research into the topic (Smith and Stansfield, 1995).

These OOTW activities, combined with traditional military roles, will continue to test the fortitude of the U. S. in the coming years. Unfortunately, as noted by President Bush in 1990, "No amount of political change will alter the geographic fact that we are separated from many of our most important allies and interests by thousands of miles of water" (Bush, 1990). This geographic fact strikes at the crux of the problem. The previously held concept of forward basing has been replaced by the idea of force projection whereby the United States makes its presence felt through the rapid response of combat capability (Rice, 1990). To support our allies under the Air Force goal of "Global Reach, Global Power," the U. S. military must have a robust, rapid transportation capability. Unfortunately, the military presently finds itself in a period of declining airlift assets (Correll, 1995). Even with the C-17 Globemaster III coming on line, the U. S. is deployment-constrained by airlift availability (Fogleman, 1995).

U. S. Military Transportation Limitations. The U. S. Air Force's C-5 and C-141 fleets are aging. Beginning in 1994 the first USAF C-141s were retired from service and placed in the Aerospace Maintenance and Regeneration Center near Davis-Monthan AFB, Arizona. The declining capacity of U. S. sealift, including the Merchant Marines, has exacerbated this growing problem (Gourdin and Trempe, 1992; Kassing, 1992). Deploying to foreign shores has become more of a common occurrence for the U. S. military just when those same forces are least suited to support such a mission. This forces the movement of assets using a limited amounts of airlift and sealift.

The more the Armed Forces have to move in order to make the desired statement, or provide a specific capability, the tougher the task. Constraints upon airlift will always exist, but the size of the deploying package of the future is being affected by the systems being acquired today. Reducing the size of future deployment footprints today is one key to force projection in the new world order.

U. S. Air Force Mobility Planning. The method of deploying forces is unique to the situation at hand but follows some general principles (Cheney, 1991; Strucker, 1993). The process typically is initiated from outside the military service when a military capability needs to be projected into some area of the world. The taskings vary greatly and can include humanitarian operations such as disaster relief, all the way up to the projection of combat power, such as Operation DESERT STORM (Schraeder, 1993). The civilian leadership determines that military options need to be exercised and tasks the services to respond (Shank, 1991; Strucker, 1993). In all cases, the military leadership is involved in the planning of such activities, although it may not be the lead agency in the

planning effort. In planning for civil disaster, the Federal Emergency Management Agency (FEMA) coordinates the planning, with the military participating in areas where it can assist. When moving assets via military transportation, FEMA and others are responsible for providing movement characteristics to the military and are victims of the same capability limitations faced by military planners when responding to requests for military assistance (Schrader, 1993).

Shank, et al, describe this response process as Crisis Action Planning (Shank, 1991). Although disaster response agencies do crisis planning as well, this particular research is focused exclusively on the movement of a military capability. In general, for a tasking involving the projection of an "air-to-ground" capability such as that envisioned for the Joint Strike Fighter, a combat command would be tasked to send aircraft to a designated location for a specified mission. This tasking comes in the form of an Operation Order and includes all the details necessary for the movement. The method of tasking a specific capability is the five-digit UTC. This code (e.g. 3FKM1 represents a 24 ship F-16 LANTIRN package) encompasses all people and equipment required to support a specific capability (Grier, 1993).

Due to time constraints, accomplishing the movement of this capability typically requires airlift. The amount of airlift required is pre-determined and loaded into the Joint Operational Planning and Execution System (JOPES) and then extracted by Air Mobility Command (AMC) aircraft schedulers (AFM 10-401, 1994). AMC then works to get the right amount of airlift to the deploying unit, typically within days. The amount of airlift available is relatively constant (and very limited), so the size of the deployment package

determines how many units can be moved at once. In JOPES, AMC and other involved agencies are able to find out what the airlift requirement is, the movement priority, and the tasking for each package by monitoring the Time-Phased Force Deployment Data (TPFDD) system (Little, 1993).

The TPFDD interfaces with the Contingency Operations/Mobility Planning and Execution System (COMPES) which is the base-level database used in the Air Force for deployment planning and execution (AFM 28-740, 1987). It is through COMPES that the deployment footprint of a weapon system is finalized. The COMPES database lists every piece of equipment which a deploying unit must bring in order to meet its Designed Operational Capability (DOC) Statement. The DOC is typically a classified headquarters-directed tasking which specifies what to maintain for deployment, and in what condition (AFM 10-401, 1994). Typically the DOC specifies which UTCs to have ready and how much notice allowed to move them (24-hours, 48-hours, etc.). The relative capability of a unit to meet its DOC tasking is reported weekly through a weekly Status of Resources and Training System (SORTS) Report which is briefed up the chain of command to the Air Staff level (AFI 10-201, 1995). It is through the relative C-rating (the score assigned in doing a SORTS Report) and tasked response time (from the DOC Statement) that the combat command leaders decide which unit to select for a particular tasking.

The obvious disparity here lies in that the combat commanders want it all, and they typically want it now--whereas the airlift capability constrains how much can be moved at any one time (Grier, 1993; Kassing, 1992; Shank, 1991). If a package could be

made smaller, it would require less airlift and the surplus airlift capability could then be re-allocated to areas that would otherwise have received lower priority taskings. The method of making it smaller ties back to the COMPES system used at base-level to size the packages in the first place. Although the tasking process is top-down, the requirements process is very bottom-driven with the deploying unit ultimately responsible for specifying their airlift requirements (AFR 28-740, 1987).

These activities lead to the peacetime practice of modeling wartime scenarios in order to better prepare for the real thing. Current modeling is focused on the lift and scheduling aspects of a deployment. Very little attention is given to the building block of the process, the size of the package to be moved, which is generally treated as unchangeable in current systems. This hole in the current modeling of deployment operations results in a developing aircraft program office, such as the Joint Strike Fighter Program Office, being forced to manually size the deployment package. In addition, there are no modeling tools available which include weapon system concepts and component alterations or technology advances in order to show their impact on the deployment footprint.

Problem Statement

The purpose of this research is to develop a tool for deployment footprint analysis. This study models a general dual-role fighter configuration from a deployment perspective by using deployment data from existing aircraft of similar functionality. The

model simulates what a Joint Strike Fighter (JSF) aircraft "may" look like from the deployment footprint perspective.

Research Questions

1. What is the relationship between the number of aircraft deployed and the deployment footprint?

    a. What is the minimum quantity of material required to deploy a dual-role fighter?

    b. How does that quantity change with an increased number of deployed aircraft?

2. Can a deployment footprint model be developed for the Joint Strike Fighter?

    a. What areas of greater concentration of equipment does the model identify that could be reduced by design trade-offs, resulting in a smaller deployment footprint?

    b. What are the effects of projected design and technology advances on the deployment footprint of the JSF aircraft?

Methodology

The first task in this three-phase process involves the analysis of a general fighter aircraft footprint equation showing the relationship between the number of aircraft deployed and the size of the package required to support it. Phase One applies the concepts of linear regression to current aircraft systems to create a model for the total package weight or personnel versus the number of aircraft deployed. In Phase Two, a multi-level model showing the relative influence of specific items (e.g. aircraft

subsystems, non-flying support equipment, and spares) on the total aircraft support package is built. Phase Three is the comprehensive analysis of effects on the deployment footprint for the possible Design and Technology Advances (DTAs). This analysis uses the model developed in Phase Two, and shows the effects of the DTAs on the total footprint.

Assumptions

Because the model being developed applies to a future weapon system, some critical assumptions were made and approved by the JSF Program Office for use on this project. In general these apply to the type of data used and the design and technology analysis. The specific assumptions, exceptions, and planning factors are detailed in Chapter III.

Scope/Limitations

The JSF is a new weapon system whose footprint prediction is derived from existing aircraft of similar function. This limits the predictive value of the equation to a system which is based upon today's technology. Because the JSF will not be fielded until 2007, the limitations of the model give the initial equation value only at the generally predictive level. Only after the prime weapon system contractor is selected and the configuration baseline is finalized can an accurate prediction of footprint be finalized.

Management Implications

Historically, 95 percent of all weapon system logistics are baselined by the completion of the Program Definition and Risk Reduction Phase (Ware, 1995). If the program office were able to analyze various design options from the perspective of the deployment footprint, it would be possible to make trade-offs early in the design of future aircraft that might make dramatic reductions in the deployment footprint of the Joint Strike Fighter. This model will provide the link between system acquisition and deployment footprint planning. The use of a future-oriented footprint analysis during the early stages of an acquisition program will allow for trade-offs to accommodate unacceptable footprint requirements or levy additional requirements if operational capabilities so dictate. As a tool, the model will provide a new input into the trade-off analysis process, whereas footprint was previously an afterthought.

Chapter Summary

This chapter provided the background and introduction for the development of a deployment footprint model. The JSF fighters intended purpose and acquisition were described and the basics of the systems acquisition process were explained. The specific deployment planning systems used within the Air Force, such as COMPES and JOPES, were described and their role in deployment footprint development were outlined. Two research questions were specified and the research methodology and organization were introduced. In general, the methodology illustrated a three-phase process which will result in the development of three products: an equation showing the relationship between

the number of aircraft deployed and the size of the corresponding deployment package, a multi-level model showing the relative influence of different classifications of deployed items, and analysis using the model of JSF envisioned design and technology changes and how those would impact the deployment footprint of the model. This foundation details the need for studying the deployment footprint and the immediate applicability to the Joint Strike Fighter program.

II: Literature Review

Chapter Overview

This literature review covers information pertaining to modeling in general as well as the entire deployment process. A thorough understanding of these areas is critical to understanding the development process of a deployment footprint model. The emphasis is on the technical aspects and current applications of modeling in the deployment environment.

Introduction

Deployment planning and execution within the military can vary greatly from humanitarian operations, such as disaster relief (Schrader, 1993), to the projection of combat power. Planning for military operations takes many forms and usually involves the use of models to test a planned course of action. Most deployment models are focused on the primary force projection constraint in the military today--lift.

Review of Previous Research

Modeling. Joseph Brierly, in an "Overview of Computer Logistics Modeling," describes the six categories of models and modeling techniques (Brierly, 1993). Deterministic modeling involves the manipulation of numerical input data and has many computer-based applications. Stochastic modeling typically involves probabilistic functions or some Monte Carlo simulation. Algorithmic models use mathematical

equations or programs to resolve highly complex issues. Optimization uses the idea of constraints and an objective function which is to be maximized or minimized to reach the best possible solution. The use of Artificial Intelligence in a standard algorithmic process is the fifth modeling technique and allows for the inclusion of inferential thinking in modeling a scenario. The final area, Simulation, actually incorporates many of the components of each technique in an attempt to create an electronic reality. These techniques and methodologies were created to minimize costs and provide the decision-maker with a better basis for comparison. This idea of reduced costs explains why the military uses models in the operational deployment and acquisition processes. The use of deployment models, in particular, allows for the analysis of potential scenarios without the associated cost.

Deployment Modeling. Deployment operations currently rely on several systems to perform some of the aforementioned modeling. At base-level, each wing is required to prepare deployment loadplans using the Computer-Aided Load Manifesting System (AFI 10-403, 1994). This system is designed to pull equipment data from the Contingency Operations/Mobility Planning and Execution System (COMPES) into a model of the interior of any number of airlifters. The operator determines in advance how to position the cargo on the aircraft floor to maximize the available weight and area. Advanced loadplanning allows for the rapid response of a unit when tasked to actually move. For a fighter such as the F-15E, an 18-ship aircraft deployment could involve around 20 loadplans, in any combination of airlifters.

Another system for modeling is the Automated Mobility Schedule of Events (AMSOE). AMSOE allows for the scheduling of an entire deployment timeline, for any number of support airlifters, with any combination of arrival and departure times. This system is particularly useful in analyzing the capability of a unit to support a deployment (AFI 10-403, 1994).

Another model, when used in the planning role, is COMPES itself. The data provided by COMPES comes from what is referred to as the Pilot Unit, or that unit responsible for the preparation of the Air Force standard for that particular aircraft type and quantity. Using the LOGPLAN function of COMPES, individual units are able to tailor the standard deployment package to fit their unique requirements and better prepare for the peculiarities of their unit (AFR 28-740, 1987).

At the Major Command and Joint Staff level, other models simulate the actions needed to set up a capability and then to maintain it. The mobility-related models typically address movement issues, such as how to move combat forces to support a war on the Arabian Peninsula or in Korea. The methodology behind all these models is the input of hard data and the time phasing of activities until all units are in place. In general, each program relies on footprint data derived from a given database (COMPES for Air Force units) which has been uploaded into some joint-service database in order to run a coordinated effort. After the cargo requirements are downloaded, airlift capabilities are added, prioritization occurs, limitations are addressed, and ultimately outputs provide delivery dates, queuing issues, and airlift utilization rates (Shank, 1991).

Current modeling in the deployment arena is focused on the airlift and scheduling aspects of a move. Little attention is provided to the building block of the process, the size of the package to be moved. Existing models simply deal with what the deploying organization uploads as the movement requirement. Presently there is no capability to model alterations of weapon system concepts and technologies and their effect on deployment footprint.

Chapter Summary

Literature searches have shown, to date, that no model has been developed to relate the conceptual design of aircraft programs in the early stages of development to the deployment footprint they will command upon their ultimate delivery. This lack in modeling capability leads to the analysis of deployment aspects of new system acquisition in a piece-meal fashion. Because system designs are most easily modified in the early phases of a program, this is also the time when deployability issues should be aggressively pursued (Jackson, 1993). The Joint Strike Fighter Program Office is currently unable to iteratively assess potential design and technology advances as they affect the deployment footprint with existing models. This shortfall drives the need for this research. Despite a lack of current research in this area, this study will show that it is possible to empirically model deployment footprint planning in a developing weapon system.

III: Methodology

Chapter Overview

The methodology behind the research process is detailed for the development of the deployment footprint equation, spreadsheet model, and analysis of the design and technology advances. The process is broken into the Research Design and Variable Validation, with additional discussion on Modeling Assumptions, Limitations, and Predictions of Outputs.

Introduction

The purpose of this research is to develop a tool for deployment footprint analysis during system development, focusing on the Joint Strike Fighter as it enters Phase I, Program Definition and Risk Reduction. This study models a general dual-role fighter configuration from a deployment perspective by utilizing deployment data from existing aircraft of similar functionality. The model focuses on what a Joint Strike Fighter (JSF) aircraft may "look" like from the deployment footprint perspective, with added capabilities to model other existing, or developing systems. Because 95 percent of all logistics requirements are determined by the acquisition decisions made in Phase I (Ware, 1995), the early analysis of various design options from the perspective of the deployment footprint could allow for design trade-offs which drive dramatic reductions in the deployment footprint.

Research Design

The first task in this three phase process involves the development and analysis of a general fighter aircraft footprint equation showing the relationship between the number of aircraft deployed and the size of the package required to support it. Using linear regression, a mathematical equation was developed which shows a relationship between the number of aircraft deployed and the size of the deployment package as measured by weight (in pounds) and in the number of personnel. Phase Two used the detailed deployment data from the Contingency Operations/Mobility Planning and Execution System (COMPES) to build a multi-level model illustrating the relative influence of specific items (e.g. aircraft subsystems, non-flying support equipment, spares) to the total aircraft support package. The final phase involved manipulating the model to analyze specific advances envisioned by the JSF Program Office and/or the weapon system contractors.

Because the JSF will not be fielded until 2007 and technology will continue to advance, the limitations of the model give the regression equations value only to the general predictive level. Additionally, because the spreadsheet model is being developed for a future weapon system, some assumptions were made and approved by the JSF Program Office for use on this project. In general these apply to the type of data used and are included in the Implementation of Research Design section.

Variable Validation

Variables of interest in this model include the use of Primary Authorized Aircraft (PAA) as the independent variable in the linear regression analysis (Phase One), and the coding used in Phase Two of the research. The use of PAA as the driver behind footprint sizing was based on a need to maintain the study in an UNCLASSIFIED mode. The primary user and sponsor, the JSF Program Office, wanted to use Sortie Generation Rates (SGR) but could not provide the data in an unclassified form. Because SGR is driven by factors such as PAA, JSF approved the use of PAA as the basis for analysis. The dependent variable is either the cumulative weight of equipment or number of personnel of the Aviation and Intermediate Level Maintenance UTCs.

The codes used in Phase Two (see Appendix D) were created in order to logically break the variety of cargo into a smaller number of groupings. The category types, titles, and acronyms were developed to further this grouping, approved by the JSF Program Office, and reviewed by the primary weapon system contractors.

Research Questions

1. What is the relationship between the number of aircraft deployed and the deployment footprint?

a. What is the minimum quantity of material required to deploy a dual-role fighter?

b. How does the quantity of materials change with an increased number of deployed aircraft?

2. Can a deployment footprint model be developed for the Joint Strike Fighter?

a. What areas of greater concentration of equipment does the model identify that could be reduced by design trade-offs, resulting in a smaller deployment footprint?

b. What are the effects of JSF design and technology advances on the deployment footprint of the JSF aircraft relative to the general fighter model?

Predictions

This deployment footprint model fills a void in the link between new weapon system acquisition and deployment planning. The use of a future-oriented footprint analysis during the early stages of acquisition will allow trade-offs to accommodate reduced footprint limits or demonstrate to decision makers where footprint limits are unrealistic given proposed designs. As a tool, the model provides a new input into the trade-off analysis process, whereas deployment footprints have previously been only afterthoughts.

Implementation of Research Design

Research Approach.

Phase One: The study applies simple linear regression to current aircraft systems, modeling total package weight or personnel versus PAA. This predictive equation results in a point estimate on deployment footprint baseline for analysis by the JSF Program Office. The concept is to show the validity of the relationship between PAA and weapon

system deployment footprint by making a point estimate of a future system needs based on current technologies.

Phase Two: Using current COMPES deployment data on six different aircrafts 18 PAA deployment packages, a developmental model shows the relative contribution of certain characteristics to the deployment footprint. This model will allow for weapon system baseline system selection (primarily the F-16 Block 40 with LANTIRN for the specific JSF application of the model) from one or more of the six available weapon system data sets.

Phase Three: Using the model developed in Phase Two, this study completes an analysis of three potential Design and Technology Advances (DTAs) which cause changes to the projected footprint. The specific changes are: on-board oxygen generation, on-board power and cooling, and the use of advanced ground support equipment. These three DTAs were selected because the JSF Program Office highlighted them as areas of interest as the system design is formalized

Steps -- Phase One

1. Collect and analyze data on standard Air Force deployment packages from six operating weapons systems including the Aviation and Intermediate Level Maintenance (ILM) UTCs. This data is extracted from the Manpower and Equipment Force Packaging System (MEFPAK) which is updated by the Headquarters United States Air Force Directorate of Concepts and Integration (HQ USAF/LGX) and is based on inputs from the Pilot Units responsible for the respective UTCs. The data used from each UTC

includes the total cargo weight and number of personnel. Appendix E gives the specifics on the data used and the specific fields of interest.

2. Complete and analyze a regression against all aircraft packages. Using the statistical package "Statistix," complete a simple linear regression using the appropriate data (Appendix E) and report the results, including the point estimate for the independent variable (PAA) equal to 18. Eighteen is used because it is the projected Air Force authorized squadron size for the JSF.

Steps -- Phase Two

1. Collect data from the Contingency Operations/Mobility Planning and Execution System (COMPES) Logistics Detail (LOGDET) on the 18 PAA packages for all weapon systems of interest.

2. Download the data into Microsoft Excel 5.0 and format by removing all unneeded data, then add in selected fields until the data is formatted as in Appendix C.

3. Create three new fields on each data set (TYPE-CAT-SUB) and categorize the sub-components of each UTC (to the Container-level) using the coding system from Appendix D.

4. On a composite level, create a general fighter deployment footprint model showing the relative contribution of each component and item to the total package. The model allows for the selection of baseline aircraft and the manipulation of configurations to show relative reductions or increase in deployment footprint when compared to the baseline.

Steps - Phase Three

1. Based upon the model developed in Phase Two, analyze three specific Design and Technology Advances and their relative and composite effects on the deployment footprint if implemented into the system.

2. In Phase Three of the research (for the JSF-specific analysis), the selected baseline will be the F-16 C/D Block 40, with LANTIRN. Analysis of the DTAs uses this baseline and incorporates three weapon system modifications.

Modeling Assumptions. For the purpose of this research and analysis there are some critical assumptions which must be understood. Some of these are standard planning factors, and others are unique to the research at hand and were approved and/or recommended by the JSF Program Office for use on this project.

a. The Air Force categorizes movement requirements commonly using C-141 equivalent loads. This equates to 45,000 pounds of cargo per C-141, or 6824 cubic feet, or 858 square feet, depending on the analysis being performed.

b. The movement and storage of Petroleum, Oil, and Lubricants (POL) is not a required part of a 30-day aviation package.

c. All bomb-bodies and hardware are assumed to be in-place. Current policy has pre-positioned stocks of munitions throughout the world, as well as in floating storage and deployable munitions packages. However, the JSF model includes only those munitions assets included in an aviation UTC as used by a flying squadron when deploying today.

d. A flying squadron deploys with only those special purpose vehicles which are not included in pre-positioned War Reserve Materials, rented, or leased. Exceptions include aircraft tow vehicles, Aerospace Ground Equipment (AGE) tow vehicles referred to as Bobtails, forklifts and other military-unique materials handling equipment.

Footprint Exceptions. Because the planning for the deployment footprint is programmed around a 30-day package, the following assets will not be included in this model:

a. External Fuel Tank Build-Up capability is typically deployed when the War Reserve Material Tanks are moved to the theater of operations. The requirement to bring the external Fuel Tank Build-Up capability generally adds around 16 personnel and less than two short tons of cargo. Additionally, the entire concept of drop tanks may not be a factor in the JSF weapon system.

b. Aircraft Battle Damage Repair (ABDR) Teams typically include 14 to 15 personnel and are usually not deployed as part of a 30-day package. The standard aviation UTC includes a limited 30-day ABDR capability.

c. Most major engine systems have a two-person Expert Engine Team capable of deploying to support operations. Due to the very small personnel requirement this entails (and no equipment) and the emerging engine technology planned for the JSF engines, this package will not be included in the package.

d. Current deployment planning has the Fuel Support requirements either deploying as a separate package, or being in-place. Although fuel support, such as trucks,

pumps, test equipment, and personnel, are required in a deployed environment, they are not included as part of the aviation package, nor are they included in packages today.

JSF-Unique Planning Factors. To the greatest extent possible, data is restricted to independent, active-duty, non-composite wing, non-quick-response UTCs. The following data sources and planning factors were approved by the JSF Program Office:

a. Data to be used: F-16C/D, F-16 HARM, F-16 LANTIRN, F-15E, F-117A, and the A-10 Aviation and ILM UTCs. In establishing a baseline for the weapons system contractors, Headquarters Air Combat Command, Directorate of Requirements (HQ ACC/DR) also included Fuel Tank Build-Up data which this model and the linear regression equation do not incorporate.

b. The use of a composite wing data set would skew the results from the planned independent package. Additionally, composite wing deployment packages reduce the footprint primarily in personnel and are typically less than 4,000 pounds of cargo in difference from an independent package.

c. A Quick Response UTC is manned and equipped for operations less than 7 days.

d. The JSF is intended to independently deploy as an 18 PAA squadron, operating for 30 days, therefore the model includes only independently deploying systems.

e. Data is restricted to active duty units as much as possible.

The dependent variable for the spreadsheet model is one of three options: weight, cubic foot, or square foot. Weight was selected because the Joint Operational Planning

and Execution System (JOPES) uses this data for scenario studies, and Transportation Feasibility Estimator when validating war-fighting scenarios. Cubic Foot (or "cube") is the standard Navy unit of measure for sealift movement. Square foot is used to show the effects when using airlift since one is more likely to cover all the available floorspace before exceeding the aircraft's rated maximum carrying capacity.

Model Limitations. The JSF does not exist, and therefore there is no real JSF data with which to build this model. The model developed is a conglomeration of deployment data from many current aircraft recommended for use by the JSF Program Office. Because of this, the statistical and empirical interaction between the subsystems cannot be validated. For example, installing a Molecular Sieve Oxygen Generating System (MSOGS) on an aircraft would eliminate the need for a Liquid Oxygen (LOX) Cart in a deployment package. If such an action is taken, the model is not designed to automatically increase the equipment levels to account for the increased on-aircraft support required of an on-board oxygen generating system. These values can be approximated by the operator who can manually increase or decrease factors in the equation.

In addition, the model cannot keep track of all relationships between data points within itself (e.g. when the LOX cart is decremented in favor of an MSOGS, the "Support-of-Support Equipment" entries for the LOX Cart will not automatically decrement by the corresponding amount). This study will not address this issue other than to note that the added MSOGS will likely have a increased Support-of-Support Equipment requirement similar to the amount that would decremented by the deletion of

the LOX Cart. However, as with the previous example, these changes are possible when the model manipulator makes changes in the manual mode.

Chapter Summary

The results of this research are two tools for the JSF Program Office to use in the development and analysis of the aircraft's deployment footprint. The dual-role fighter equation allows JSF to make a prediction on the deployment footprint of the aircraft by modeling against existing weapon systems. The second tool, the spreadsheet model, allows the program planners to manipulate individual footprint components and see the effect on the total deployment package. Additionally, this effort analyzes three specific notional advances when the system is deployed and the effects of each on the total footprint.

IV: Observations, Findings, and Analysis

Chapter Overview

This chapter provides a synopsis of the data collection, manipulation, and analysis process and outlines the findings of the research. Detailed answers are provided to each of the original research questions, as well as a summation of other findings not covered in addressing the research questions.

Observations on Data Collection and Manipulation

The data collection revealed a very dynamic deployment planning environment wherein the Unit Type Codes (UTCs) are continually updated by the Pilot Units. Although these updates provide more current data, the data collection, manipulation, and analysis process required freezing the data set at a specific point. For the linear regression equation purposes, the data set was frozen after the release of the December 1995 Manpower and Equipment Force Packaging System (MEFPAK) report. For the Contingency Operations/Mobility Planning and Execution System (COMPES) data used in developing the spreadsheet model, the data set was frozen upon receipt of data for each of the 11 different deployment packages.

Data manipulation included transferring the COMPES data into Microsoft Excel 5.0 and then formatting it according to the spreadsheet model requirement. This process included the categorization of the data according to Appendix D and analysis of the breakout by weapon system (Appendix F). This analysis permitted the combination of

specific categories into a more general format and led to a reduction in the number of equipment category options (Appendix G). The end result was a more usable product.

Research Findings

The data analysis answered both the research questions intended, as well as other questions which developed as research progressed. Below are the answers to the initial research questions, with additional findings included in the following section.

Question 1. *What is the relationship between the number of aircraft deployed and the deployment footprint?* Regression analysis reveals that the relationship between the number of aircraft deployed and the deployment footprint is linear. The conclusion of a linear relationship is the result of running a linear regression of the data in Appendix E and analyzing the resulting equation. The regression used Primary Authorized Aircraft (PAA) as the independent variable, with weight (in pounds) or number of personnel as dependent variables. This analysis was performed using 13 available combinations of Aviation and Intermediate Level Maintenance (ILM) UTCs (Appendix E) for six different aircraft types in either 8-, 12-, 18-, 21-, and 24-PAA sizes. Additionally the analysis was performed with the 8-ship F-16 LANTIRN package removed because it does not have an accompanying ILM UTC. The cumulative data from the two UTCs (Aviation and ILM) was used in the regression analysis and the equations derived as follows:

All 13 Cases

Personnel: TOTAL PERSONNEL = -15.955 + 22.542 * PAA

Adjusted R-Square of .8432, and a JSF point estimate of 384 personnel

Equipment: TOTAL CARGO = -21.712 + 17.477 * PAA

Adjusted R-Square of .8276, and a JSF point estimate of 292.8 Short Tons

12 Cases (3FKM6 removed)

Personnel: TOTAL PERSONNEL = -21.444 + 22.814 * PAA

Adjusted R-Square of .7735, and a JSF point estimate of 389 personnel

Equipment: TOTAL CARGO = -1.1321 + 16.456 * PAA

Adjusted R-Square of .7301, and a JSF point estimate of 295.1 Short Tons

Analysis of the test statistics and residuals indicate this to be a reasonable model for the data used in the model (Appendix H). This point estimate equation is applicable only for the weapon systems chosen and is based on the data sets approved by the JSF Program Office.

Question 1a. *What is the minimum quantity of material required to deploy a dual-role fighter?* This question was intended to determine an absolute minimum quantity of material which must be deployed. Using the derived linear equation with all 13 cases, the intercept for equipment is -21.71 short tons, and the intercept for personnel is -15.96. Both intercepts had extremely high p-values indicating the values had no statistical significance. Additionally, the available range of PAA (8 to 24) does not include the intercept point where PAA would be equal to zero. Extrapolation of the equation below

the value of 8 is improper in this situation. The end result is that there is no useful predictive information to be gleaned from these intercepts.

Question 1b. *How does that quantity change with an increased number of deployed aircraft?* This question is intended to gain insight to the relative increase in deployment footprint size as the number of aircraft increases. The per aircraft increase for personnel is 22.54, with a p-value less than .0001. This indicates that this slope is statistically significant over the specified range of aircraft which is currently 8 to 24. Similarly, for cargo the per aircraft increase in weight of 17.48 was also significant (p-value less than .0001). This analysis of the per aircraft increase in cargo and personnel incorporates all 13 weapon system configurations. The regression and residual analysis is included at Appendix H.

Based on the regression equation using all 13 cases from currently fielded systems, the Joint Strike Fighter can expect an increase of 22.54 personnel and 34,960 pounds of cargo for each additional aircraft. For the JSF projected 18-ship package this equates to a total package of 384 personnel and a total weight of 585,600 pounds. Using the conversion factor of 45,000 pounds per C-141 (and ignoring the personnel space and baggage requirement) this equates to 13 C-141 equivalents.

<u>Question 2</u>. *Can a deployment footprint model be developed for the Joint Strike Fighter?* This research indicates that it is possible to model a deployment footprint model for a developing weapon system. The model developed by this research allows for the use of any of six different data sets (F-16 Block 50 HARM, F-16 Block 40 LANTIRN, F-16 Block 30 C/D, F-15E, F-117A, A-10) as a baseline to model the future

deployment footprint subject to any modifications intended for the JSF. General details of the model are addressed later in this chapter while specifics of the model manipulation are covered in Appendices I and J.

Question 2a. *What areas of greater concentration of equipment does the model identify that could be reduced by design trade-offs, resulting in a smaller deployment footprint?* Due to the flexibility built into the model, the specific category of equipment which is the largest contributor to the overall footprint varies, according to the weapon systems chosen as the data sources for the intended baseline. The JSF program has selected the F-16 Block 40 LANTIRN as its configuration for comparison purposes and as such analysis here will focus upon that configuration as well as the compilation of all data points into a "generic" dual-role fighter. The F-16 Block 40 LANTIRN data shown below reveals the largest contributor to the deployment configuration is the FS-GEN or Flightline Maintenance category at 21.66 percent.

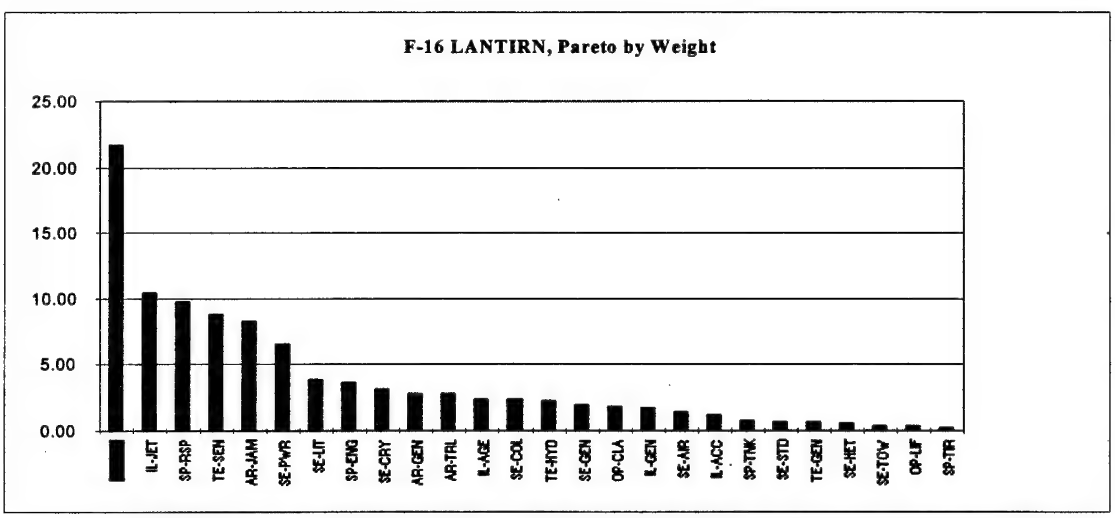


Figure 1. F-16 LANTIRN, Pareto by Weight

When the spreadsheet model is created using all six weapon systems, the data reveals that on average, the largest contributor to the deployment configuration is also the FS-GEN or Flightline Maintenance category at 8.76 percent.

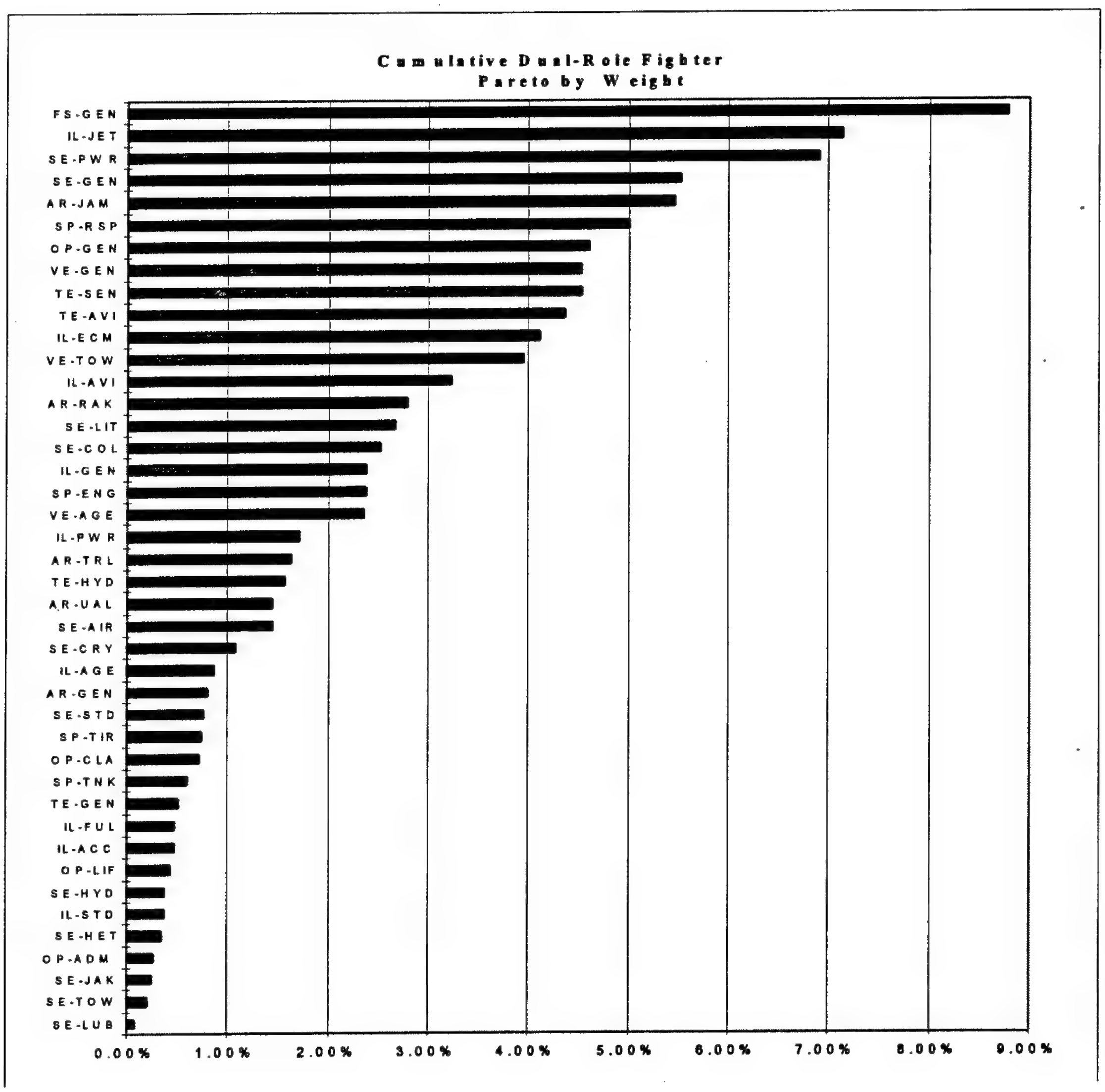


Figure 2. Cumulative Dual-Role Fighter, Pareto by Weight

A complete summary of the total weight, cubic foot, and square foot contributions as revealed by the model are included in Appendices K and L.

Question 2b. *What are the effects of projected design and technology advances on the deployment footprint of the JSF aircraft?* The JSF Program Office intended to provide a list of anticipated technological design advances that would allow the researchers to analyze for impact upon the JSF baseline (F-16 Block 40 with LANTIRN) utilizing the developed model. At the present stage of writing, the technological design advances have not been communicated by the JSF program, and therefore the analysis was done on three likely advances.

1. On-Board Oxygen Generation System: Installation of an on-board oxygen generation system to provide air for the pilots would eliminate the need for containerized oxygen on the aircraft. In the model, the Liquid Oxygen (LOX) cart is included in category Support Equipment (SE), Cryogenics (CRY), or SE-CRY. For the baseline aircraft selected, the F-16 LANTIRN, SE-CRY also includes Liquid Nitrogen servicing and Hydrazine servicing. The analysis assumed a 50 percent reduction in SE-CRY category because of the elimination of LOX carts from the package.

Original Weight: 16,445 pounds, representing 14.81 percent of all SE

Resulting Weight: 8,222 pounds, representing 7.99 percent of all SE

This resulted in a 1.81 percent reduction in the Aviation UTC total weight, and a 1.53 percent decrease in the weight of the total package.

2. On-Board Power and Cooling Systems: Installation of systems to provide a self-starting power supply and the capability to provide conditioned air during

maintenance could result in the elimination of three categories of Support Equipment, SE-PWR (Power), SE-COL (Cooling), and SE-HET (Heat). Reduction of these items by 100% (i.e. elimination) reduces the weight of the deployment package by 50,575 pounds, and represents a 45.53 percent decrease in the Support Equipment contribution to the Aviation package. This translates to an 11.16 percent decrease in the weight of the aviation UTC, and a 9.42 percent reduction in the weight of the total deployment footprint.

3. *Advanced Ground Support Equipment:* Armstrong Laboratory at Wright-Patterson Air Force Base is conducting research on advanced ground support equipment in a program called the Multi-System Aircraft Support System (MASS). This piece of Aerospace Ground Equipment (AGE) will combine six or more pieces of AGE into a modular unit. The net effect, if developed, fielded, and utilized, is the elimination of SE-PWR (Power), SE-LIT (Lights), SE-AIR (Compressed Air), SE-COL (Cooling), SE-HET (Heat), SE-HYD (Hydraulics Servicing), TE-HYD (Test Equipment-Hydraulics), and a 50 percent reduction in SE-CRY (Cryogenics), or the aforementioned Liquid Oxygen carts. MASS is in development and is estimated to weigh 2,000 pounds when fielded and with a Basis of Issue (BOI) of one for every two aircraft (total of nine for an 18-aircraft package). MASS could eliminate 99,632 pounds of cargo while adding 18,000 pounds in "new" weight. The net effect is an 18.12 percent reduction in the Aviation UTC and a 15.21% reduction in the total package weight.

Analysis

Phase One. The regression equation provides a reasonable starting point for the JSF Program Office to baseline the ultimate deployment footprint of the JSF aircraft.. The results provide a reasonable projection, based on currently fielded systems, of how large the deployment footprint of a dual-role fighter may be. This analysis is based on the data points specified by the JSF Program Office and as such do not allow the analysis to incorporate such statistical tools as confidence intervals. This point estimate is not probabilistic in nature and is provided only to give the JSF Program Office visibility on where the deployment footprint could end up if it were based on currently operating systems and technologies. In the development of this new weapon system, the JSF Program Office can use this point estimate as a baseline for deployment package sizing limitations when the prime contractor is selected.

Phase Two. The spreadsheet model meets all the requirements of the JSF Program. The categories and sub-categories of equipment classification were approved by the JSF Program Office and incorporated accordingly. The weapon system data sets were selected by the JSF Program Office and incorporated completely. The mechanics and display fields of the model were proposed by the researchers, then modified and approved by the Program Office.

The mathematical relationships within the model were validated by the researchers. All equations were reviewed and tested using each weapon system as well as the compilation of all weapon systems into a general dual-role fighter configuration. A description of how the model functions is included in the next section of this chapter.

Specifics on the model structure and a paper copy of the model itself are included in Appendices I and J.

Phase Three. The analysis of three potential advances points out the usability of the model and was intended to show the results derived from specific Design and Technology Advances. The model provides the deployment footprint analysis in either weight, cubic foot, or square foot depending on the desired output. A limitation of the model, as discussed before, is the inability to automatically adjust other affected categories of equipment as changes are made. For example, if AGE is deleted by incorporating MASS into the deployment package, the model does not decrement the spare parts, tools, and personnel who deploy to support the previously large number of pieces of AGE. Similarly, the addition of 18,000 pounds of cargo (nine MASS units) had to be done manually.

Model Description

The overall purpose of the developed model is to allow aircraft developers to create an intended aircraft deployment footprint estimate by selecting data from existing aircraft of similar subsystem designs. In areas where no direct comparison exists, the model allows the contributing data to be either increased or decreased by user supplied percentages to make up for the fact that no similar design may presently exist. Printouts of the model are shown in Appendix J.

Once the data is selected, the model calculates either the weight, square footage, or cubic volume of the deployment package, segregates the quantity as either in support

of the aviation or intermediate logistics portion of the deployment package and then by major category (e.g., Category-A Support Equipment versus Test Equipment) or sub-category (e.g., Category-B Support Equipment for Heating versus Support Equipment for Cooling). The model calculates each Category-B as a percentage of the parent Category-A, as well as the Category-A as a percentage of the Aviation or the Intermediate Level Maintenance portion of the deployment package. Ultimately the model calculates what percentage of the deployment package is Aviation versus Intermediate Level Maintenance.

The model is intended to provide model manipulators with the flexibility to create an aircraft baseline as close in design to the envisioned aircraft without limiting the data selection options.

Chapter Summary

This chapter delineates the results of the research effort as two usable tools for addressing deployment footprint issues. The first tool, the regression equation, allows the user to get a point estimate for a developing system based on similarly tasked fielded weapon systems. Both linear equations are statistically very significant and provide a good point estimation tool for use over the appropriate range of values.

The second tool, the spreadsheet model, provides the user a method of making weapon system baseline decisions then altering the configuration of the selected single or hybrid system and seeing the effects on the system's deployment footprint. The model

presents the effects of both baseline and configuration alterations both numerically and graphically.

V: Results and Conclusions

Chapter Overview

The results and conclusions of the research effort are delineated in this chapter. The spreadsheet model developed for the Joint Strike Fighter (JSF) Program Office is the primary product resulting from this research. The model is discussed, as well as the limitations of the research and significance of the research to developing weapon systems.

Significance of Research

Weapon system acquisition is an iterative process where trade-offs are made based upon current and future impacts. The concept of deployment footprint analysis and modeling provides a link between the acquisition process and the actions necessary to estimate the size of a deployment package when the system is developed. The JSF Program Office is at a point in the development of the next generation of dual-role fighter where a tool such as the deployment footprint spreadsheet model can link current decisions directly to the impact on the deployment footprint.

Research Limitations

The research effort was limited by the amount of time available to ensure the robustness of the equipment classification process. Certain facets of the research were limited in scope due to the time available, but to the greatest extent possible all efforts

were coordinated with the JSF Program Office and operational units. The following is a summation of the specific areas where the research limitations appear:

Data Entry. The entire process was a learning experience with respect to equipment classification. The possibility exists that differing opinions on equipment functionality may have led the two authors to classify a piece of equipment of similar function, but from different data sets, into conflicting Category A or B areas.

Data Accuracy. The development and maintenance of Unit Type Codes (UTCs) is an on-going process which is controlled by the Pilot Units at operational bases. It is possible that the data used in this model has become obsolete due to changes by the Pilot Units after the sample was already obtained.

Model Limitations. The developed model is limited by a number of factors, many of which are unavoidable or a result of the experimental design. Model assumptions and limitations are detailed in Chapter III of this thesis. Some of the model limitations are result of the lack of flexibility the researchers had with regards to time and available data.

The FS-GEN category was created after the data reduction phase of the research was approximately 75 percent complete. The large variety of flightline maintenance equipment accompanying each deployment package led to the creation of over 20 classifications in the FS category. It became apparent that the relatively small quantities involved in each of these sub-categories would quickly be "lost" in the roll-up of the data. Adding to this problem, some aircraft deployment packages lacked adequate information to allow proper categorization by the researchers. As a result of these factors the FS category was not broken out below the Category-A level.

At the conclusion of the data reduction process, the magnitude of the FS-GEN category showed that despite the small size of the individual FS sub-categories, when taken as a whole, FS was a potentially significant player in the overall deployment footprint. Had the data been more closely attributable to the aircraft's functional designs, this limitation may not have been encountered.

Another limitation of the model is that of internal model dynamics. When the model is loaded with an aircraft's deployment data, there would be a significant advance in the model's usability if the deployment footprint relationship between subsystems of the aircraft were integrated. For example, if the model were robust enough to "understand" that when a Molecular Sieve Oxygen Generating System (MSOGS) is added to the aircraft configuration, that the Liquid Oxygen (LOX) aspects of the design along with the LOX support equipment, spares, etc., were now unnecessary and could be decreased, and that a MSOGS system on average increased the support equipment, spares, etc., by another factor, then the user could make single point changes to the model relative to design and get an instantaneous output.

Recommendations for Future Research

As the first known researchers in this area, the authors noted many possible areas for further research. First, the interactive effects mentioned in the Model Limitations section warrant additional attention. A detailed study of even a single weapon system, such as the F-16C with LANTIRN, would allow for the model to be modified to incorporate possible interactive effects. A second area for potential research would

include the complete breakout of the Flightline Maintenance category into either a task-based, or user-based classification versus the organizational classification used for this research. Either of these would allow the weapon system developer to more closely tie aspects of the weapon system design directly to flightline maintenance activities. This research could be duplicated from a weapon subsystem functionality perspective instead of the functional organization taken here. For example, instead of using categories based on functional alignment of the maintenance organization, break the equipment and personnel out by the maintenance action performed, such as changing a tire or an engine. Finally, the model could be expanded or tailored to include other weapon systems such as air-to-air fighters or even airlifters.

Conclusions and Summary of Thesis

This study was sponsored by an operational organization to provide a usable tool for analysis of the deployment footprint of a specific developing aircraft. The result of this effort is two-tiered. First, the research showed that although no work of this type had been documented previously, it could be effectively accomplished at the operational level. Secondly, the spreadsheet model developed provides an additional means of analysis for the JSF as the Program Office weighs trade-offs during weapon system development. This model proves the concept for follow-on efforts for other weapons systems, but does not provide the operational tool for any organization other than the JSF Program Office. This model is focused on a specific aircraft type--the dual-role fighter--and does have the internal data to support direct application to any other aircraft type.

Although the concept has been shown to be viable, application beyond the JSF will require additional data collection, manipulation, and analysis.

The results of this research effort allow the JSF Program Office and its weapon system contractors to conduct deployment footprint trade-off analysis early in the JSF life cycle, during the Program Definition and Risk Reduction phase of the program. This three-phase research effort identified and addressed specific research questions and resulted in the creation of a versatile model for use by the JSF Program Office. In Phase One, an equation showing the relationship between the number of aircraft deployed and the size of the corresponding deployment package was developed and shown to be significant. In Phase Two, a multi-level model showing the relative influence of different classifications of deployed items was developed and validated for the JSF. Phase Three used the spreadsheet model developed in Phase Two to provide a detailed analysis of how three likely changes would impact the deployment footprint of the JSF.

This research, and the resulting model, serve to elevate deployment footprint analysis from an afterthought in the acquisition process to a driving force behind acquisition decisions. Although this model applies only to the JSF, it serves as proof of concept for any future weapon system striving to reduce the load upon an already constrained U. S. military airlift system.

Appendix A: Definition of Terms

Aircraft Battle Damage Repair: The people and equipment necessary to repair damage to an aircraft in the field.

Automated Mobility Schedule of Events: An unclassified computer program which automates the scheduling of the deployment process at the unit level.

Aviation Unit Type Code: Typically coded 3XXXX0, where the 3 represents the aviation designation. This package includes all requirements for a specific aircraft type and quantity. The package is designed to support the system in accordance with the Mission Capability Statement.

Baseline: The subjective result of a decision on a basis for comparison. The baseline for a deployment footprint analysis is a weapon system, or combination of weapon systems, which serve as the basis for comparison to some other program. In this case the F-16 Block 40 with LANTIRN is the baseline selected for comparison with the developing Joint Strike Fighter.

C-Rating: The score when doing SORTS reporting (1 through 5).

Computer-Aided Load Manifesting: An unclassified computer program for planning aircraft loading operations.

Contingency Operations/Mobility Planning and Execution System: A computer system which provides planning and movement data to deploying units.

Cube: 12"x12"x12" Also referred to as cubic foot.

Deployment Footprint: The sum total of all equipment, people, and personal gear which deploys in support of a weapons system. The footprint can be expressed in terms of C-141 equivalents, Weight, Cube, or Square Foot.

Design and Technology Advances: Joint Strike Fighter improvements which are being considered for inclusion in the final aircraft design.

Designed Operational Capability Statement: A classified document which specifies individual unit taskings for deployment operations. Includes UTC and response times.

Drop Tanks: Externally mounted fuel cells. May include the Conformal Fuel Tanks on the F-15E which cannot be jettisoned in flight, but are removable.

Dual-Role Fighter: A weapon system capable of fulfilling more than one type of mission. This designation typically refers to a fighter aircraft which has air-to-air and air-to-ground capabilities.

Intermediate Level Maintenance: Those maintenance actions which go beyond the remove and replace or simple repair actions of flightline maintenance, yet can be performed in an operational environment without being sent to a maintenance depot.

Joint Operational Planning and Execution System: A classified computer system which is the primary means of planning and executing deployment operations.

Joint Strike Fighter: The next-generation multi-role fighter (also referred to as a dual-role fighter).

LOGDET: A term which describes products created by COMPES. Typically refers to the specific UTC printout which includes all cargo deployment information.

LOGPLAN: A portion of COMPES which provides individual unit deployment data.

Low Altitude Navigation Targeting Infrared for Night: A system used on the F-15E and F-16 for targeting and navigation. Consists of two pods mounted under the aircraft and components internal to the airframe.

Manpower and Equipment Force Packaging System: A HQ USAF product which gives deployment data for each UTC.

Pod Mounted Electronic Counter Measures: Electronic Counter Measure systems which are externally mounted versus integral to the weapon system. Typically seen on F-16s and A-10s.

Pod Mounted Sensors: Targeting and/or navigation components which are externally mounted. Specifically referring to LANTIRN, and typically seen on F-16s and F-15Es.

Primary Authorized Aircraft: The force sizing designator which specifies the exact number of aircraft authorized to deploy on a given package.

Sortie Generation Rate: Typically classified, this number specifies the number and duration of missions a weapons system is expected to fly in contingency operations.

Square Foot: 12"x12"

Status of Resources and Training System: The reporting system for relaying readiness data from the unit level up to HQ USAF.

Support Section: The function which maintains assets for use by flightline maintenance specialists.

Time-Phased Force Deployment Data: A detail listing of a UTCs tasked to deploy. This can include timing information and serves as the basis for airlift scheduling in contingency operations.

Unit Type Code: An alpha-numeric code representing a package of people and equipment deployable to perform a certain function.

Weight: Stated in pounds unless specified otherwise (i.e. Short Tons, or 2,000 pounds)

Appendix B: Acronyms

ABDR	Aircraft Battle Damage Repair
AMSOE	Automated Mobility Schedule of Events
Aviation UTC	Aviation Unit Type Code
CALM	Computer-Aided Load Manifesting
COMPES	Contingency Operations/Mobility Planning and Execution System
DOC Statement	Designed Operational Capability Statement
DTAs	Design and Technology Advances
ECM	Electronic Counter Measures
ILM UTC	Intermediate Level Maintenance Unit Type Code
JOPES	Joint Operational Planning and Execution System
JSF	Joint Strike Fighter
LANTIRN	Low Altitude Navigation Targeting Infrared for Night
LOGDET	Logistics Detail
LOGPLAN	Logistics Plan
MEFPAK	Manpower and Equipment Force Packaging System
PAA	Primary Authorized Aircraft
SGR	Sortie Generation Rate
SORTS	Status of Resources and Training System
TPFDD	Time-Phased Force Deployment Data
UTC	Unit Type Code

Appendix C: Unit Type Code Data Summary

18 PAA F-117A AVIATION, PILOT UNIT, 49FW (HOLLOMAN, NM)

UTC	AC	PAA	DEP ECH	INC NO.	ITM NO.	SUF ITM	CC	NSN	NOUN	QTY	WT	LTH	WTH	HGT	CUBE
3FATA	F-117	18	E1	0006	00	00	A	1730006408080	LONG MD-1 TOW BAR	1	550	297	58	29	290
3FATA	F-117	18	E1	0010	00	00	A	6115004208486	GENERA AM32A60A	1	3280	118	61	67	280
3FATA	F-117	18	E1	0020	00	00	A	4120ND002383F-9	-9 AIR CONDITIONE	1	7270	138	78	84	524
3FATA	F-117	18	E1	0025	00	00	L	6115010616610X	AM32A-86 DIESEL	1	0	118	80	70	383
3FATA	F-117	18	E1	0025	01	00	A	6115010616610X	AM32A-86 DIESEL	1	5860	90	80	70	292
3FATA	F-117	18	E1	0025	02	00	A	6130012220475	D.C. PACK	1	550	28	40	24	16
3FATA	F-117	18	E1	0201	00	00	L	1670008204896CT	463L PALLET, LOADE	1	0	88	108	56	308
3FATA	F-117	18	E1	0201	01	00	A	1670008204896CT	PALLET, CARGO ACRF	1	300	88	108	3	17
3FATA	F-117	18	E1	0201	02	00	A	1670009694103CT	TOP NET, CARGO	1	15	12	12	12	1
3FATA	F-117	18	E1	0201	03	00	A	1670009962780CT	SIDE NET, CARGO	2	20	12	12	12	1
3FATA	F-117	18	E1	0201	04	00	C	8145011189873	MOBILITY BIN LG	1	500	88	30	60	92
3FATA	F-117	18	E1	0201	04	01	S	5140000104776	CTK, APG (ROLLAWAY	6					
3FATA	F-117	18	E1	0201	04	02	S	6625P5002666600	TEST SET, FCS	1					
3FATA	F-117	18	E1	0201	04	03	S	1560ND011254F	DISPLAY UNIT	1					
3FATA	F-117	18	E1	0201	04	05	S	5835CTKA/C	CTK, A/C JACKING	1					
3FATA	F-117	18	E1	0201	04	06	S	5835L00TOW	CTK, TOW	1					
3FATA	F-117	18	E1	0201	04	07	S	5140006084757	CTK, LOX SERVICIN	1					

UTC	Unit Type Code
AC	Aircraft Type
PAA	Primary Authorized Aircraft: Number of aircraft tasked for that UTC
DEP ECH	Deployment Echelon Code: Used to sequence taskings
INC NO.	Increment Number: Used to sequence taskings. Each INC NO. represents a different item, or packed piece of equipment.
ITM NO.	Item Number: Used to specify items on a loaded increment.
SUF ITM	Suffix Item: Used to specify items in a container. Do NOT have individual weights or dimensions
CC	Cargo Category Code: L = Loaded item, A = Stand-Alone item, C = Container, S = items in a container.
NSN	National Stock Number
NOUN	Short item description
QTY	Quantity
WT	Weight (in pounds)
LTH	Length (in inches)
WTH	Width (in inches)
HGT	Height (in inches)
CUBE	Cubic area (in cubic feet)

Appendix D: Model Categorization Codes

TYPE

AV - Aviation UTC
IL - Intermediate Level Maintenance UTC

Aviation UTC CAT and SUB-level Categories

CAT	SUB	Title
SE		Support Equipment
	AIR	SE-Air
	COL	SE-Cooling
	CRY	SE-Cryogenics
	GEN	SE-General (Note 1)
	HET	SE-Heat
	HYD	SE-Hydraulics
	JAK	SE-Jacks
	LIT	SE-Lighting
	LUB	SE-Lubricants
	PWR	SE-Power
	STD	SE-Stands
	TOW	SE-Towbars
AR		Armaments
	GEN	AR-General (See Note 2)
	JAM	AR-Jammers
	RAK	AR-Missile Racks
	TRL	AR-Trailers
	UAL	AR-Universal Ammunition Loaders
TE		Test Equipment
	AVI	TE-Avionics
	GEN	TE-General (See Note 3)
	HYD	TE-Hydraulics
	SEN	TE-Pod Mounted Sensors
SP		Spares
	ENG	SP-Engines
	RSP	SP-Readiness Spares Package
	TIR	SP-Aircraft Tires
	TNK	SP-Drop Tanks
FS		Flightline Maintenance
	GEN	FS-General (See Note 4)

VE		Special Purpose Vehicles
	AGE	VE-Aerospace Ground Equipment Support/Bobtail
	GEN	VE-General
	TOW	VE-Aircraft Towing
OP		Admin, Intel and Operations
	ADM	OP-Administrative Support
	CLA	OP-Classified and Intel
	GEN	OP-General (See Note 5)
	LIF	OP-Life Support

ILM UTC CAT and SUB-level Categories

CAT	SUB	Title
IL		Intermediate Level Maintenance
	ACC	IL-Accessories
	AGE	IL-Aerospace Ground Equipment
	AVI	IL-Avionics
	ECM	IL-Pod Mounted ECM
	FUL	IL-Fuel Cell
	GEN	IL-General (See Note 6)
	JET	IL-Jet Engine Shop
	PWR	IL-Power Supply
	STD	IL-Stands

NOTES: The "General" category includes those items which did not readily fit into a major category, or were used by only one or two aircraft types and were not uniquely significant based on functionality.

1. In SE this included such things as fire bottles and Dash-21 equipment (aircrew ladders, engine covers, pitot tube covers).
2. In AR this included palletized AR equipment which the LOGDET showed as owned by Armaments but was not readily classifiable into another major category.
3. In TE this included any test equipment which could not be readily identified as fitting into one of the other areas.
4. In FS this included all items which would normally be found in the "Support Section" or detailed out to a host-base function at a deployed site. This includes, but is not limited to: Fuel Cell, Egress, Wheel and Tire, Flightline Electronic Counter Measure, Metals Tech, Aircraft Battle Damage Repair, Flightline Avionics, Electrics, Engine Specialist, Non-Destructive Inspection, Crash Recovery, and Parachute Shop. This subsection has been rolled up into one category which may, or may not be further researched.
5. In OP this included such things as mission planning equipment and any items which were identifiable to the deployed operations function, but not readily attributable to another major sub-category.

6. In IL this included any ILM equipment which did not fit another category. Of the six weapon systems, each identified its ILM package uniquely, and in cases where items did not fit in another category, IL-General was used.

Appendix E: Regression Data Collection

The data used in the regression analysis came from the 22 Dec 95 version of the MEFPAK, as downloaded from the HQ ACC/LGXX Homepage on the Internet (HTTP://www.acclog.af.mil/lgx/lgxx/mefpak/mefpak12.zip). HQ ACC receives it quarterly from HQ USAF and provided the data to the World Wide Web as a customer service initiative.

The specific Unit Type Codes (UTC's) used in the regression analysis are as follows:

UTC (1)	PAA	Aircraft	UTC Type(2)	Personnel (3)	Short tons (4)
3FKJB0	24	F-16 BLK 30 C/D	AVIATION	411	272.2
HFAHA0	24	F-16 BLK 30 C/D	ILM	96	141.7
3FKM70	18	F-16 BLK 30 C/D	AVIATION	364	225.9
HFAGC0 (5)	18	F-16 GEN	ILM	53	52.9
3FKP10	12	F-16 BLK 30 C/D	AVIATION	180	141.2
HFAHE0	12	F-16 BLK 30 C/D	ILM	67	75.3
3FKAA0	18	F-16 BLK 50 HARM	AVIATION	364	213.2
HFAM70	18	F-16 BLK 50 HARM	ILM	52	66.0
3FKM10	24	F-16 BLK 40 LANTIRN	AVIATION	438	274.4
HFAHA0	24	F-16 BLK 40 LANTIRN	ILM	96	141.7
3FKM30 (6)	18	F-16 BLK 40 LANTIRN	AVIATION	344	272.4
HFAGC0 (5)	18	F-16 GEN	ILM	53	52.9
3FKM60	8	F-16 BLK 40 LANTIRN	AVIATION	169	100.8
XXXXX0 (7)	8	F-16 BLK 40 LANTIRN	ILM	0	0
3FATA0	18	F-117A	AVIATION	334	295.2
HFATA0	18	F-117A	ILM	20	41.3
3FQK10	24	F-15E	AVIATION	507	324.4
HFQK10	24	F-15E	ILM	60	87.2
3FQK30	18	F-15E	AVIATION	442	173.9
HFQK30	18	F-15E	ILM	37	38.7
3FVDE0	21	A/OA-10	AVIATION	312	305.5
HEAB10 (8)	21-4	A-10	ILM	41	25.1
3FVBX0	18	A/OA-10	AVIATION	329	213.5
HEAB10 (8)	21-4	A-10	ILM	41	25.1
3FVBR0	12	A/OA-10	AVIATION	189	172.5
HEAC80	12	A-10/6 OA-10	ILM	46	56.9

NOTES:

1. The UTCs were selected based on the assumptions in Chapter III (independent, active-duty, etc.) with the corresponding ILM package coming from the appropriate ILM UTC as listed in the MANFOR Mission Capability Statement (the document is classified SECRET, however the derived information is unclassified).
2. The regression model is based on a total of the Aviation and ILM UTCs.

3. Personnel totals include aircrew members, and was taken from the "AUTH PERS" column
4. Short Ton equals 2,000 pounds. Total weight was derived from the "UTC TOTAL" column and includes all categories of cargo (i.e. BULK, OVERSIZE, OUTSIZE, etc.)
5. HFAGC0 is a common ILM package used by the Block 30 and Block 40 F-16 weapon systems.
6. 3FKM30 is the standard UTC for the Block 40 F-16 LANTIRN and was selected as the JSF weapons system baseline.
7. The 8 PAA, F-16 Block 40 does not deploy with ILM, therefore zeros (0) are used.
8. HEAB10 is a 21-24 PAA UTC that is used for both the 18 and 21 ship package.

Appendix F: Source Data

F-16 Lantirn Data		Weight	Cube	SQ FT
AR	GEN	15,227	1,233	198
AR	JAM	44,180	2,146	611
AR	RAK	0	0	0
AR	TRL	14,892	1,785	458
AR	UAL	0	0	0
OP	ADM	0	0	0
OP	CLA	9,802	908	132
OP	GEN	0	0	0
OP	LIF	1,458	462	66
SE	AIR	7,775	1,051	244
SE	COL	12,420	2,763	479
SE	CRY	16,445	1,342	299
SE	GEN	10,140	1,014	245
SE	HET	2,790	435	110
SE	HYD	0	0	0
SE	JAK	0	0	0
SE	LIT	20,760	2,565	459
SE	LUB	0	0	0
SE	PWR	35,365	3,239	539
SE	STD	3,575	1,306	208
SE	TOW	1,800	957	359
SP	ENG	19,846	2,309	328
SP	RSP	52,442	6,134	916
SP	TIR	969	114	37
SP	TNK	3,880	1,000	244
FS	GEN	116,290	12,705	1,883
TE	AVI	0	0	0
TE	GEN	3,240	208	44
TE	HYD	12,300	948	144
TE	SEN	47,472	3,797	550
VE	AGE	0	0	0
VE	GEN	0	0	0
VE	TOW	0	0	0
IL	ACC	6,358	1,393	198
IL	AGE	12,859	1,168	193
IL	AVI	0	0	0
IL	ECM	0	0	0
IL	FUL	0	0	0
IL	GEN	9,030	1,024	132
IL	JET	55,688	9,016	1,241
IL	PWR	0	0	0
IL	STD	0	0	0
Total		537,003	61,022	10,318

F-16 HARM Data		Weight	Cube	Sq Ft
AR	GEN	3,897	275	97
AR	JAM	50,490	2,366	688
AR	RAK	19,230	1,923	291
AR	TRL	23,249	3,206	690
AR	UAL	0	0	0
OP	ADM	6,523	418	66
OP	CLA	0	0	0
OP	GEN	0	0	0
OP	LIF	5,144	652	110
SE	AIR	30,040	3,904	719
SE	COL	2,640	626	106
SE	CRY	12,060	859	188
SE	GEN	13,196	2,743	666
SE	HET	2,580	333	91
SE	HYD	5,160	303	89
SE	JAK	2,106	330	66
SE	LIT	18,360	2,529	446
SE	LUB	300	60	19
SE	PWR	46,500	3,744	625
SE	STD	7,025	2,109	311
SE	TOW	1,600	561	227
SP	ENG	11,014	1,282	177
SP	RSP	35,394	3,268	523
SP	TIR	1,970	97	14
SP	TNK	0	0	0
FS	GEN	71,019	6,813	1,546
TE	AVI	0	0	0
TE	GEN	3,225	208	44
TE	HYD	11,960	724	117
TE	SEN	0	0	0
VE	AGE	24,360	2,840	420
VE	GEN	10,920	1,171	139
VE	TOW	36,000	2,685	343
IL	ACC	0	0	0
IL	AGE	4,191	413	66
IL	AVI	16,044	1,788	264
IL	ECM	0	0	0
IL	FUL	3,950	898	112
IL	GEN	36,808	5,744	689
IL	JET	62,016	7,957	1,239
IL	PWR	0	0	0
IL	STD	3,024	1,049	195
Total		581,995	63,878	11,382

F-16 C/D Data		Weight	Cube	Sq Ft
AR	GEN	1,735	158	59
AR	JAM	39,725	1,835	545
AR	RAK	18,095	1,662	343
AR	TRL	11,995	1,597	619
AR	UAL	0	0	0
OP	ADM	650	55	27
OP	CLA	5,310	321	107
OP	GEN	1,165	106	55
OP	LIF	4,545	446	94
SE	AIR	5,540	573	155
SE	COL	11,880	2,817	475
SE	CRY	9,520	730	154
SE	GEN	11,160	1,779	330
SE	HET	2,580	333	91
SE	HYD	960	123	37
SE	JAK	1,710	540	113
SE	LIT	18,360	2,529	446
SE	LUB	300	60	19
SE	PWR	44,700	3,707	628
SE	STD	3,655	1,698	257
SE	TOW	1,500	549	205
SP	ENG	19,070	2,628	378
SP	RSP	35,191	4,477	748
SP	TIR	20,530	1,270	217
SP	TNK	5,090	1,489	337
FS	GEN	74,909	7,340	1,726
TE	AVI	0	0	0
TE	GEN	3,225	208	44
TE	HYD	11,960	897	167
TE	SEN	0	0	0
VE	AGE	12,180	1,420	210
VE	GEN	10,920	1,171	139
VE	TOW	22,650	1,670	205
IL	ACC	0	0	0
IL	AGE	4,191	413	66
IL	AVI	16,044	1,788	264
IL	ECM	0	0	0
IL	FUL	3,950	898	112
IL	GEN	36,808	5,744	689
IL	JET	56,509	7,316	1,151
IL	PWR	0	0	0
IL	STD	3,024	1,049	195
Total		531,336	61,396	11,405

F-15E Data		Weight	Cube	Sq Ft
AR	GEN	4,028	369	120
AR	JAM	41,300	2,103	593
AR	RAK	0	0	0
AR	TRL	3005	357	69
AR	UAL	12,000	1,986	397
OP	ADM	590	50	23
OP	CLA	1,170	99	20
OP	GEN	3,215	393	111
OP	LIF	2,538	304	61
SE	AIR	13,200	1,773	363
SE	COL	3,600	894	155
SE	CRY	210	1	0
SE	GEN	38,240	7,244	1,447
SE	HET	3,900	509	134
SE	HYD	700	94	28
SE	JAK	3,050	496	122
SE	LIT	34,125	4,755	712
SE	LUB	1,660	221	53
SE	PWR	95,800	7,602	1,321
SE	STD	9,205	4,016	676
SE	TOW	2,200	696	277
SP	ENG	25,660	4,201	575
SP	RSP	37,021	6,612	1,141
SP	TIR	4,200	866	138
SP	TNK	2,136	507	173
FS	GEN	75,808	9,965	2,201
TE	AVI	33,508	2,509	431
TE	GEN	6,372	536	113
TE	HYD	23,500	1,689	279
TE	SEN	26,436	2,405	326
VE	AGE	18,600	1,914	291
VE	GEN	0	0	0
VE	TOW	41,600	3,164	361
IL	ACC	1,520	1,293	243
IL	AGE	0	0	0
IL	AVI	0	0	0
IL	ECM	0	0	0
IL	FUL	0	0	0
IL	GEN	7,838	1,335	228
IL	JET	58,554	5,768	799
IL	PWR	4,000	417	67
IL	STD	0	0	0
Total		640,489	77,143	14,048

A-10 Data		Weight	Cube	Sq Ft
AR	GEN	7,588	722	159
AR	JAM	68,670	3,307	968
AR	RAK	31,045	2,616	1,095
AR	TRL	0	0	0
AR	UAL	11,752	3,060	399
OP	ADM	1,069	336	66
OP	CLA	6,276	429	66
OP	GEN	0	0	0
OP	LIF	4,408	369	66
SE	AIR	8,500	858	222
SE	COL	0	0	0
SE	CRY	9,940	825	207
SE	GEN	3,480	444	79
SE	HET	1,720	222	60
SE	HYD	960	123	37
SE	JAK	0	0	0
SE	LIT	27,450	3,350	590
SE	LUB	0	0	0
SE	PWR	21,580	1,261	215
SE	STD	7,365	3,352	507
SE	TOW	1,100	381	207
SP	ENG	13,650	2,045	321
SP	RSP	36,690	3,718	540
SP	TIR	8,636	1,269	191
SP	TNK	8,453	1,572	374
FS	GEN	46,907	6,634	1,236
TE	AVI	0	0	0
TE	GEN	3,225	208	44
TE	HYD	10,480	1,040	140
TE	SEN	0	0	0
VE	AGE	22,950	2,479	358
VE	GEN	0	0	0
VE	TOW	34,460	2,188	257
IL	ACC	0	0	0
IL	AGE	0	0	0
IL	AVI	10,000	1,418	185
IL	ECM	33,500	3,482	462
IL	FUL	0	0	0
IL	GEN	6,400	990	132
IL	JET	0	0	0
IL	PWR	0	0	0
IL	STD	0	0	0
Total		448,254	48,698	9,183

F-117A Data		Weight	Cube	Sq Ft
AR	GEN	0	0	0
AR	JAM	22,800	1,122	320
AR	RAK	0	0	0
AR	TRL	0	0	0
AR	UAL	0	0	0
OP	ADM	1,761	188	41
OP	CLA	7,317	356	115
OP	GEN	108,612	16,938	1,922
OP	LIF	3,360	416	99
SE	AIR	5,720	600	143
SE	COL	72,700	5,240	748
SE	CRY	4,420	342	95
SE	GEN	14,184	1,009	214
SE	HET	3,900	700	186
SE	HYD	7,805	538	99
SE	JAK	1,525	208	58
SE	LIT	11,500	1,400	247
SE	LUB	320	51	18
SE	PWR	94,090	6,060	1,036
SE	STD	6,830	2,290	436
SE	TOW	1,650	870	359
SP	ENG	26,749	4,681	705
SP	RSP	47,599	6,090	990
SP	TIR	100	18	13
SP	TNK	0	0	0
FS	GEN	45,503	3,678	1,034
TE	AVI	37,530	2,176	272
TE	GEN	6,160	421	85
TE	HYD	6,500	377	63
TE	SEN	0	0	0
VE	AGE	18,082	2,315	353
VE	GEN	71,030	9,261	782
VE	TOW	26,300	2,068	263
IL	ACC	0	0	0
IL	AGE	0	0	0
IL	AVI	62,910	7,563	1,032
IL	ECM	0	0	0
IL	FUL	0	0	0
IL	GEN	0	0	0
IL	JET	0	0	0
IL	PWR	24,120	780	135
IL	STD	0	0	0
Total		741,077	77,756	11,860

Appendix G: Data Category Reduction

The source data for the model was built from the UTC data as provided by the pilot units. Upon categorization of this data, some previously developed categories were revealed to be of little use. Some of these categories were useless because the data of these classifications was so small, others had no data at all. As a result, categories were merged with other category B data within the same Category A family. The list below shows the migration of the categories.

SU-BEN (Support - Benches)	Merged with	FS-GEN (Flightline Support - General)
SU-TOS (Support - Tech Orders)	Merged with	FS-GEN (Flightline Support - General)
SS-GEN (Specialist - General)	Changed to	FS-GEN (Flightline Support - General)
OP-MED (Ops - Medical)	Merged with	OP-GEN (Ops - General)
OP-MIS (Ops - Mgmt Info Systems)	Merged with	OP-GEN (Ops - General)
OP-INT (Ops - Intel)	Merged with	OP-CLA (Ops - Classified)
SE-21Q (Support Equipment - Ladders)	Merged with	SE-GEN (Support Equipment - General)
SE-FIR (Support Equipment - Fire Protection)	Merged with	SE-GEN (Support Equipment - General)
SE-FUL (Support Equipment - Fuels)	Merged with	SE-GEN (Support Equipment - General)
SE-WAT (Support Equipment - Wheel & Tire)	Merged with	SE-GEN (Support Equipment - General)
VE-ICE (Vehicles - Icing)	Merged with	VE-GEN (Vehicles - General)
IL-ELE (ILM - Electrical)	Merged with	IL-GEN (ILM - General)
IL-HYD (ILM - Hydraulics)	Merged with	IL-GEN (ILM - General)
IL-PHZ (ILM - Phase)	Merged with	IL-GEN (ILM - General)
IL-PML (ILM - PMEL)	Merged with	IL-GEN (ILM - General)

Appendix H: Regression Analysis

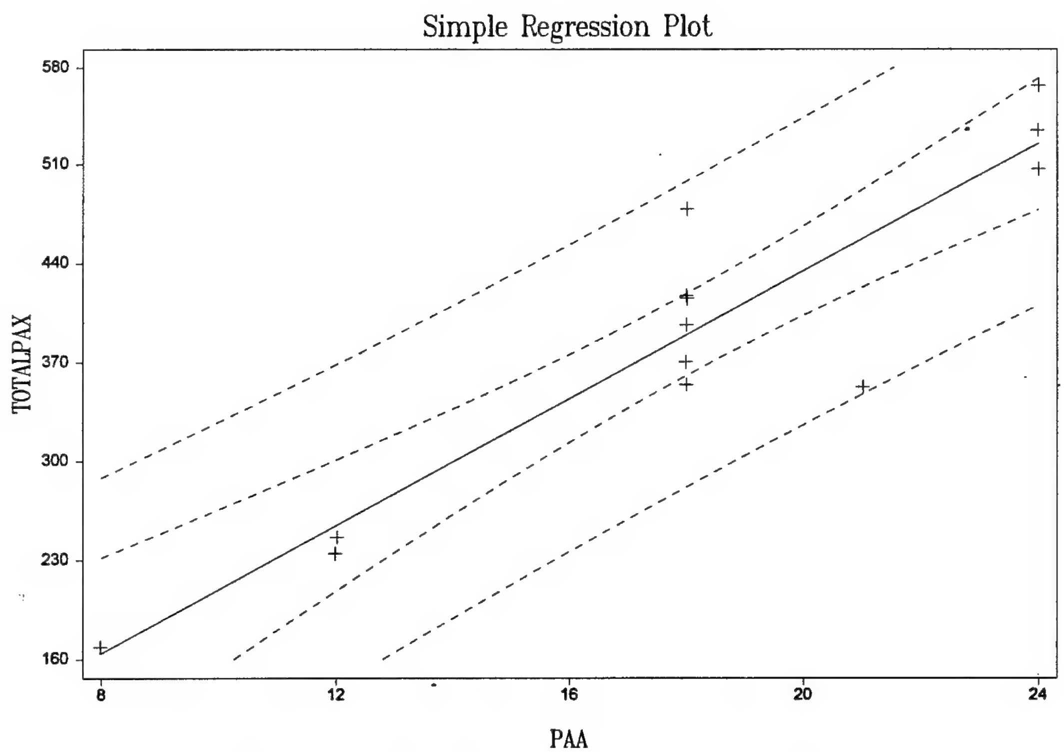
Regression Analysis of **Passenger** data (13 cases)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P-VALUE
CONSTANT	-15.9558	51.6018	-0.31	0.7629
PAA	22.5425	2.78436	8.10	0.0000

R-SQUARED	0.8563	RESID. MEAN SQUARE (MSE)	2239.93
ADJUSTED R-SQUARED	0.8432	STANDARD DEVIATION	47.3279

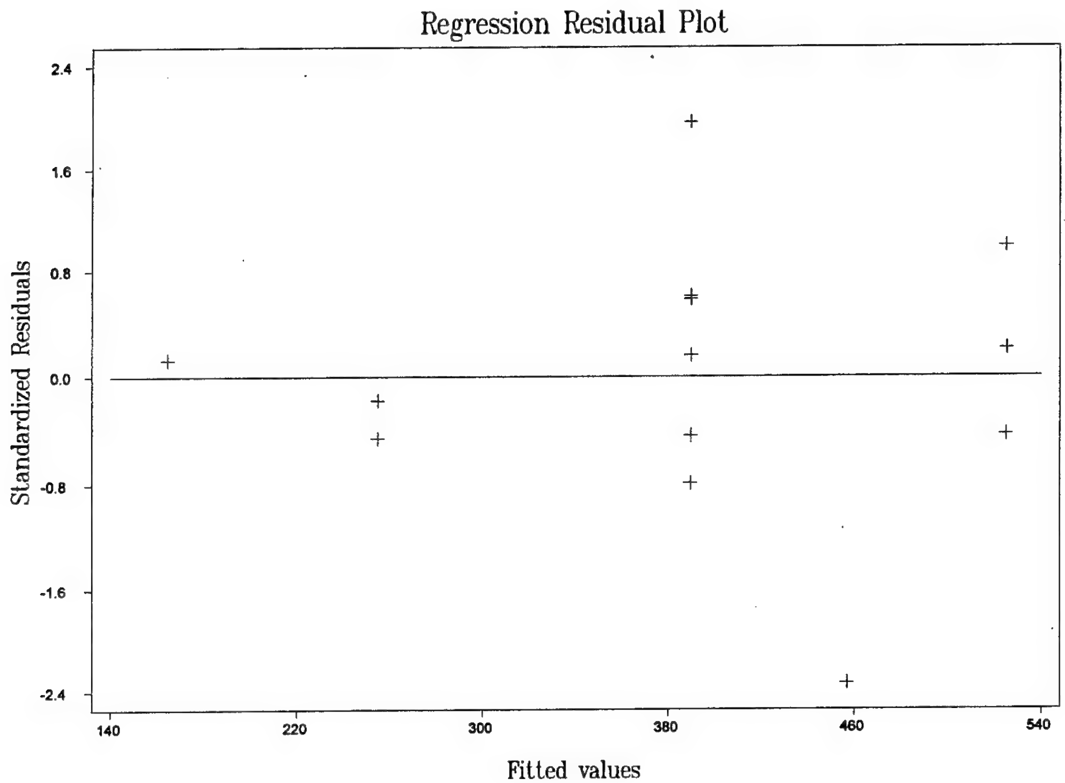
SOURCE	DF	SS	MS	F	P-VALUE
REGRESSION	1	1.468E+05	1.468E+05	65.55	0.0000
RESIDUAL	10	24639.2	2239.93		
TOTAL	11	1.715E+05			

Passenger Data Regression Plot (13 Cases)



TOTAL PASSENGERS = -15.955 + 22.542 * PAA

Passenger Data Residual Plot (13 Cases)



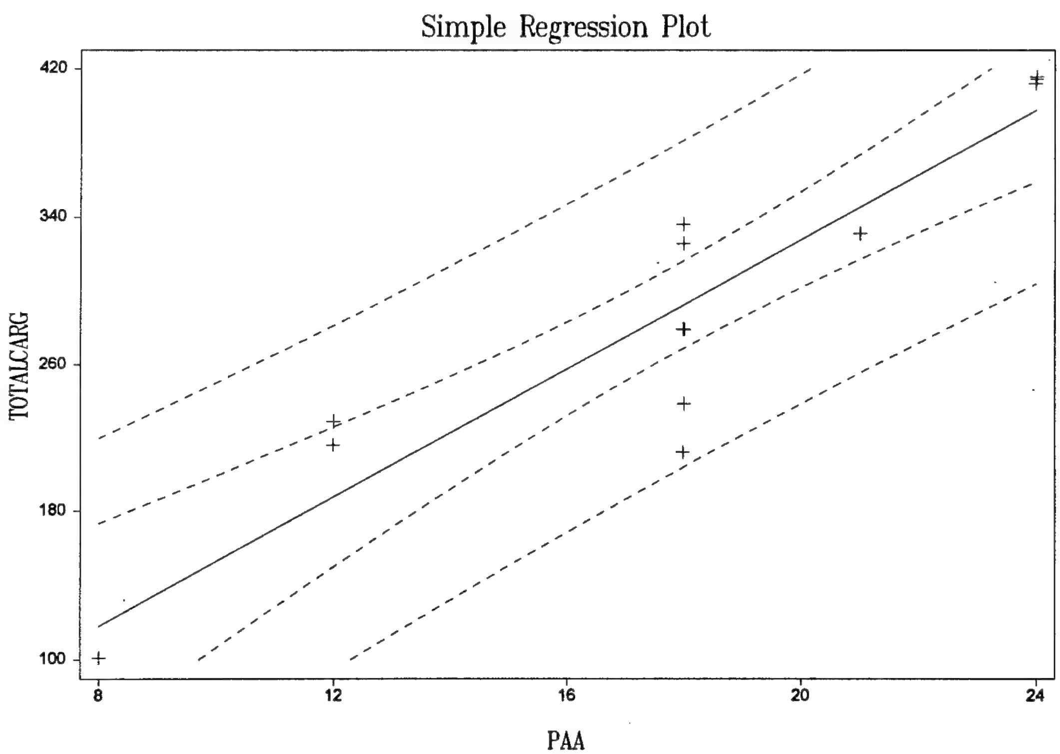
Regression Analysis of **Cargo** data (13 cases)
Calculated in Short Tons (2,000 pounds)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P-VALUE
CONSTANT	-21.7122	42.3043	-0.51	0.6179
PAA	17.4770	2.28268	7.66	0.0000

R-SQUARED	0.8420	RESID. MEAN SQUARE (MSE)	1505.47
ADJUSTED R-SQUARED	0.8276	STANDARD DEVIATION	38.8004

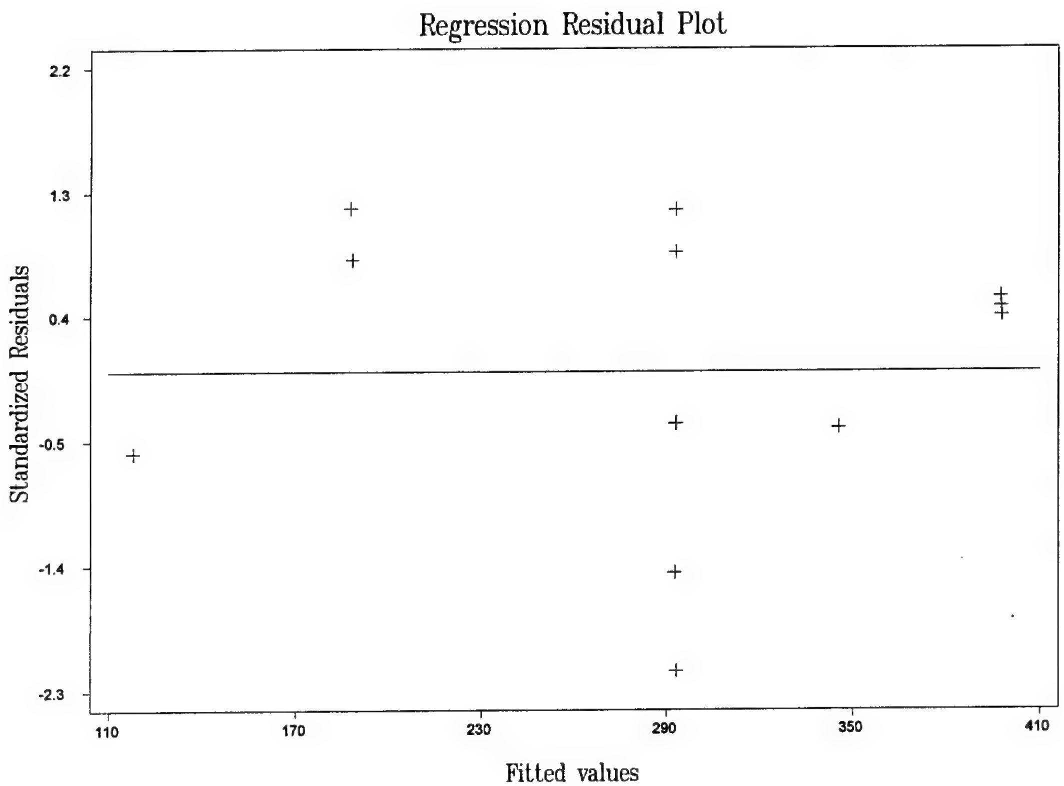
SOURCE	DF	SS	MS	F	P-VALUE
REGRESSION	1	88251.0	88251.0	58.62	0.0000
RESIDUAL	10	16560.2	1505.47		
TOTAL	11	1.048E+05			

Cargo Data Regression Plot (13 Cases)



TOTAL CARGO = -21.712 + 17.477 * PAA

Cargo Data Residual Plot (13 Cases)



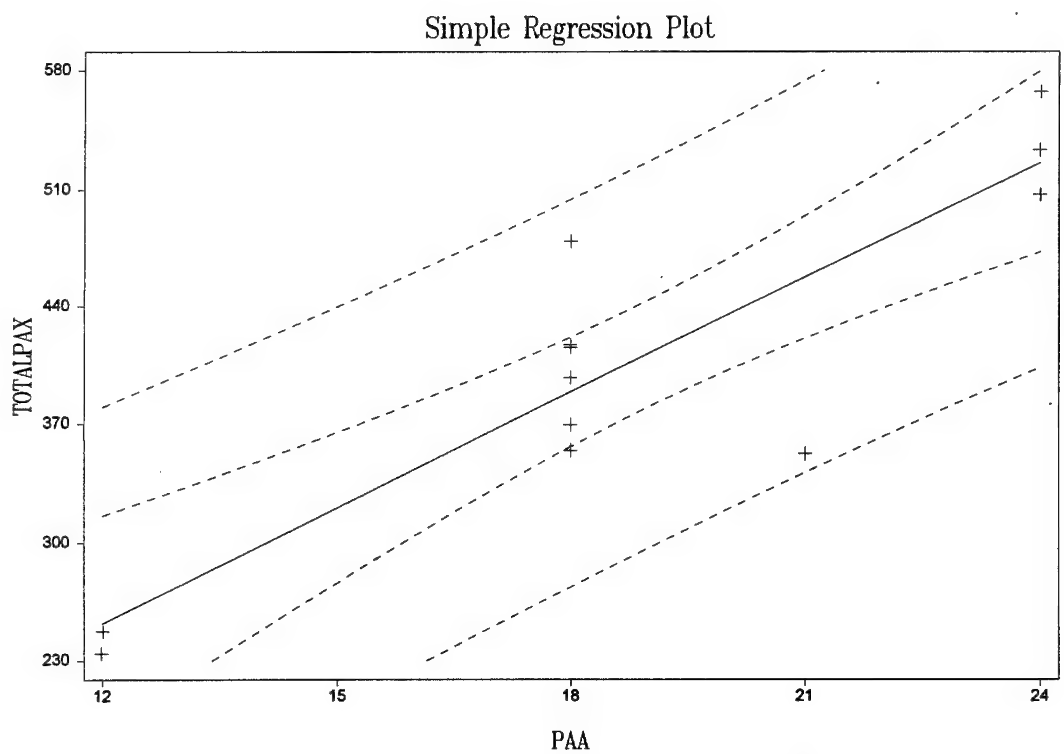
Regression Analysis of **Passenger** data with 8-ship F-16 LANTIRN removed (12 cases)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P-VALUE
CONSTANT	-21.4444	70.3626	-0.30	0.7668
PAA	22.8148	3.67415	6.21	0.0001

R-SQUARED	0.7941	RESID. MEAN SQUARE (MSE)	2460.26
ADJUSTED R-SQUARED	0.7735	STANDARD DEVIATION	49.6010

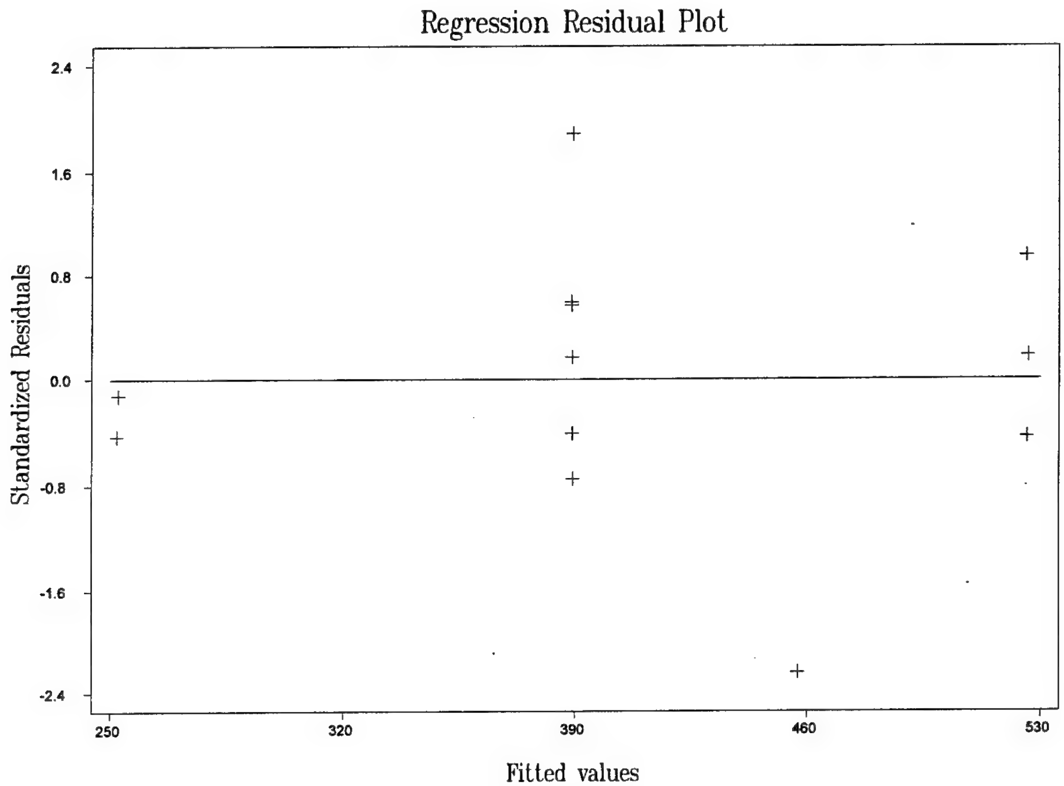
SOURCE	DF	SS	MS	F	P-VALUE
REGRESSION	1	94864.0	94864.0	38.56	0.0001
RESIDUAL	10	24602.6	2460.26		
TOTAL	11	1.195E+05			

Passenger Data Regression Plot (12 Cases)



TOTAL PASSENGERS = -21.444 + 22.814 * PAA

Passenger Data Residual Plot (12 Cases)



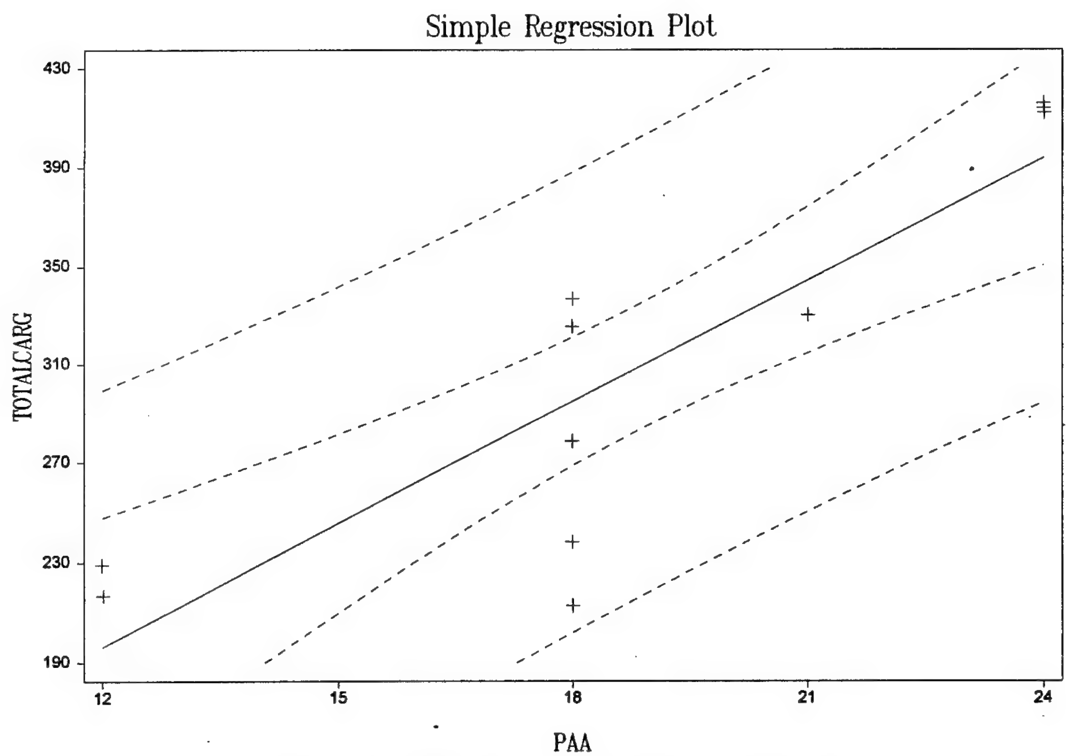
Regression Analysis of **Cargo** data with 8-ship F-16 LANTIRN removed (12 cases)
Calculated in Short Tons (2,000 pounds)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P-VALUE
CONSTANT	-1.13209	56.8243	-0.02	0.9845
PAA	16.4563	2.96721	5.55	0.0002

R-SQUARED	0.7547	RESID. MEAN SQUARE (MSE)	1604.59
ADJUSTED R-SQUARED	0.7301	STANDARD DEVIATION	40.0574

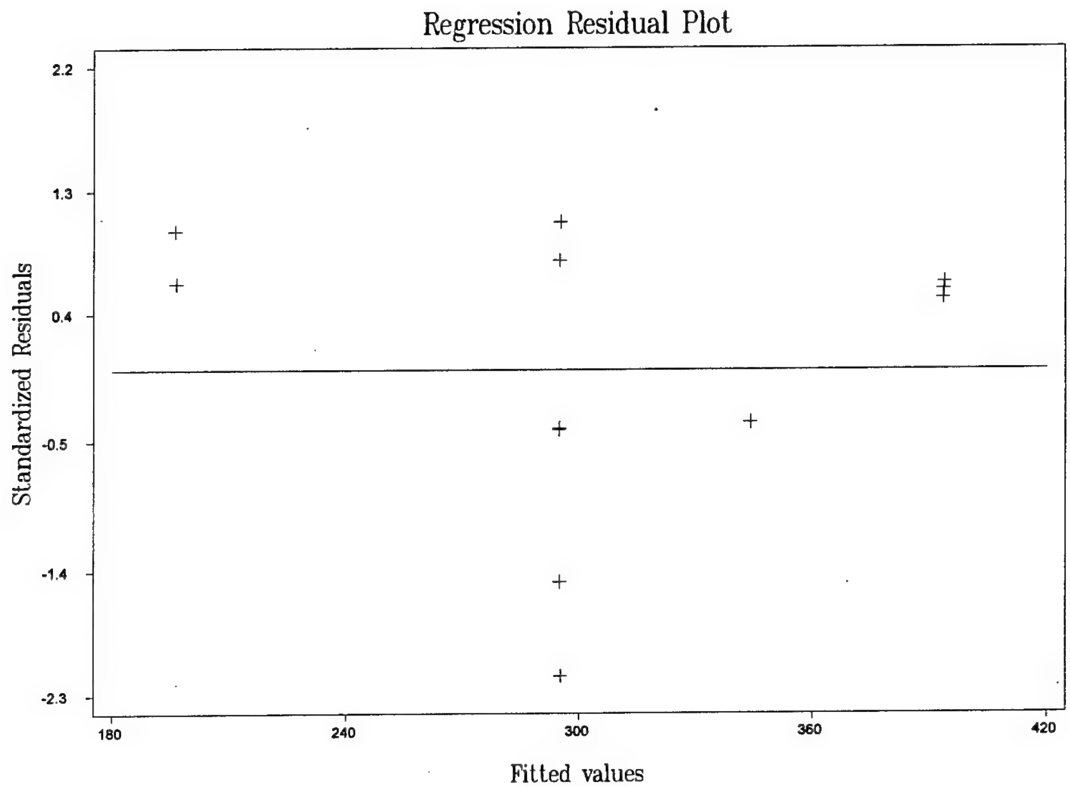
SOURCE	DF	SS	MS	F	P-VALUE
REGRESSION	1	49355.5	49355.5	30.76	0.0002
RESIDUAL	10	16045.9	1604.59		
TOTAL	11	65401.5			

Cargo Data Regression Plot (12 Cases)



TOTAL CARGO = -1.1321 + 16.456 * PAA

Cargo Data Residual Plot (12 Cases)



Appendix I: Model Description and Use

Data for the model is embedded in Microsoft Excel sheets denoted by the aircraft configuration name and the word Data (e.g., F-117A Data). The data provided on these sheets is a summation of all deployment data as it relates to those aircraft configurations as captured via the process noted in Chapter III of this thesis.

The model manipulator creates a baseline aircraft by one of two ways. The model will show the deployment configuration of either a.) a single aircraft, or b.) any desired hybrid aircraft. Selection of a single aircraft configuration is accomplished by selecting only the desired aircraft in all Category-B data selection blocks. By selecting only that aircraft, only the desired aircraft data is fed to the model and the model returns with the specified aircraft's deployment configuration.

The model manipulator can also choose to create a "hybrid" aircraft if desired. The model allows more than one aircraft to be selected for each respective Category-B data selection box. By selecting more than one aircraft configuration the model takes the average of the data for the selected aircraft. For example, If a baseline was to be developed for a single engine fighter the model manipulator would be advised to select one or all single engine aircraft as data in all Category-B data selection blocks where they apply to the engines. If this same aircraft was to be developed with a LANTIRN-like system, the model manipulator would be able to select only the LANTIRN equipped aircraft for those Category-B areas. Aircraft which do not have data for a Category-B are not selecteable. This keeps the model manipulator from lowering an average value for a

Category-B by including aircraft which do not deploy with a particular Category-B class of deployment material, inclusion of which would skew the average number downward.

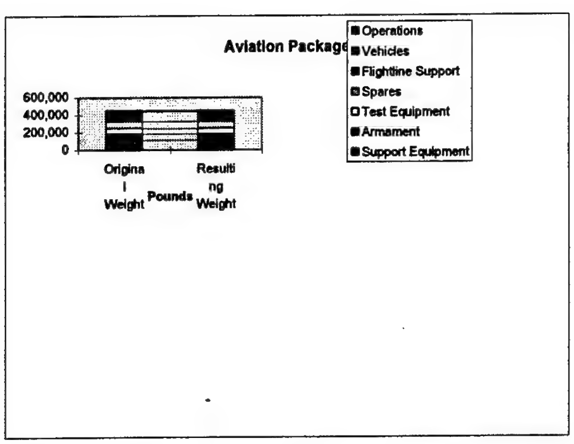
Using this method the model can be tailored to allow the design to "mimic" different aircraft for different aspects of its design. A note of caution is in order. Familiarity with the basic design and support concepts of the aircraft contributing to the dataset is advised. One example of this need is in the targeting systems of the aircraft used as data for this model. The F-117A uses an internal Infrared (IR) target acquisition and designation similar in purpose to the pod-mounted LANTIRN system. Because of the way the flying wings are organized, the F-117A IR system support is classified as avionics support, whereas the LANTIRN support is broken out as a separate LANTIRN support area. An uninformed user might improperly assume that the F-117 IR system does not require the extensive deployed support the LANTIRN system does, when in fact it has it, simply in a different classification. Ultimately, the model manipulator needs to be familiar enough with the aircraft the data is derived from to ensure that faulty assumptions are avoided.

Appendix J: Spreadsheet Model Printouts

Weight Model: Sheet 1 of 10

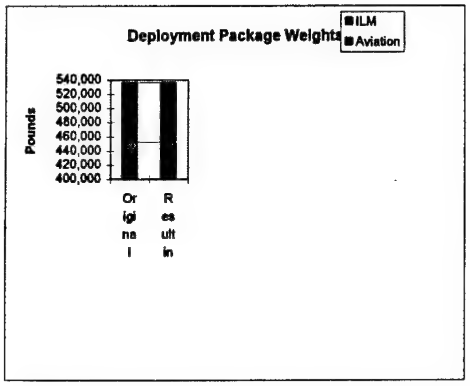
Support Equipment
Original weight
Original % of Aviation
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of Aviation

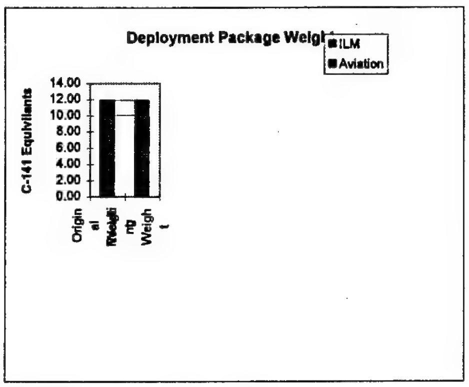
Armament
Original weight
Original % of Aviation
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of Aviation



Aviation	
Original weight	453,068
Original % of Deployment Pkg	84.37%
Resulting Weight	453,068
% of Decrease (Increase) Weight	0.00%
Resulting % of Deployment Pkg	84.37%

Weight Model: Sheet 3 of 10





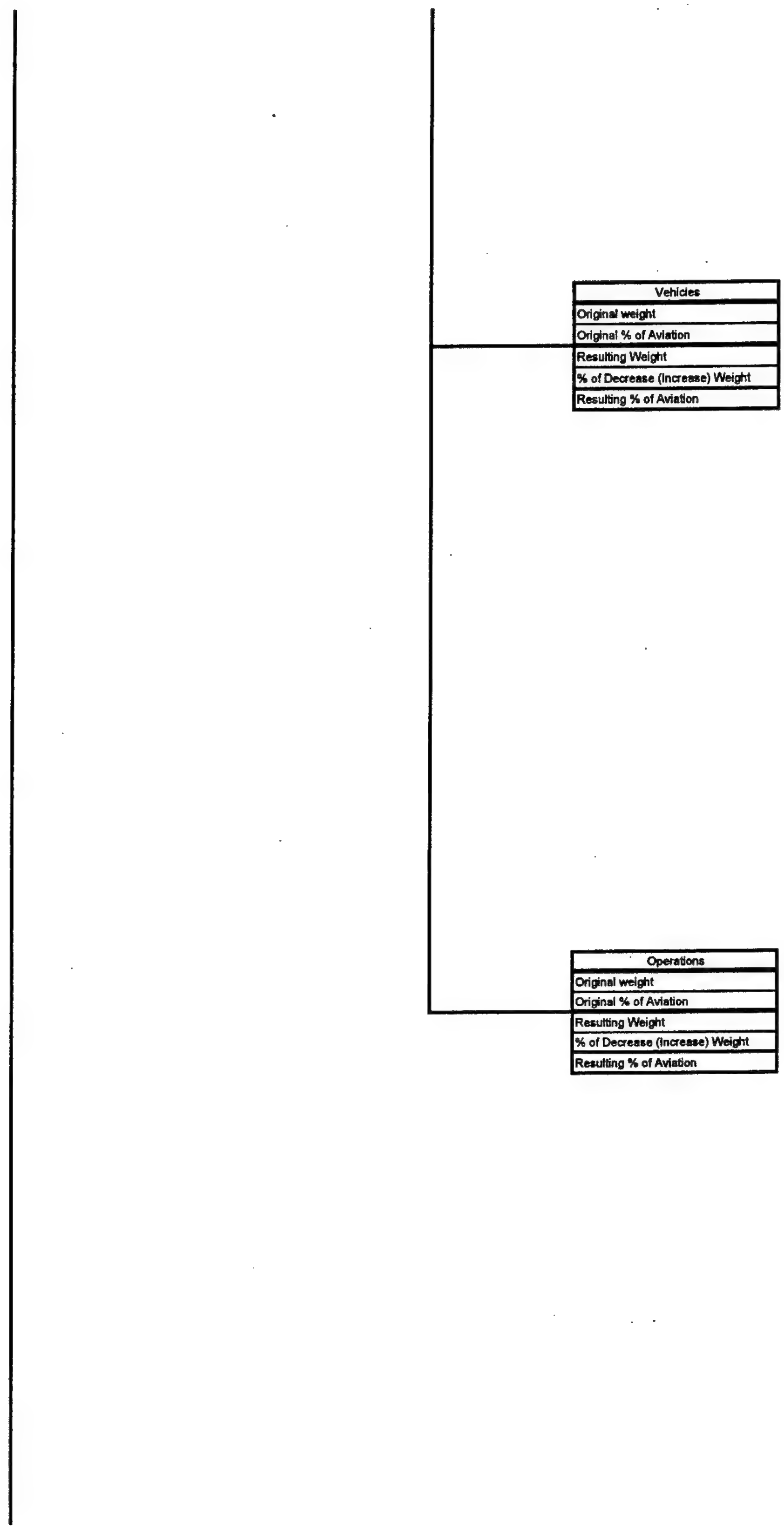
Original weight	537,003
Resulting Weight	537,003
% of Decrease (Increase) Weight	0.00%

Test Equipment
Original weight
Original % of Aviation
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of Aviation

Spares
Original weight
Original % of Aviation
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of Aviation

Flightline Support
Original weight
Original % of Aviation
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of Aviation

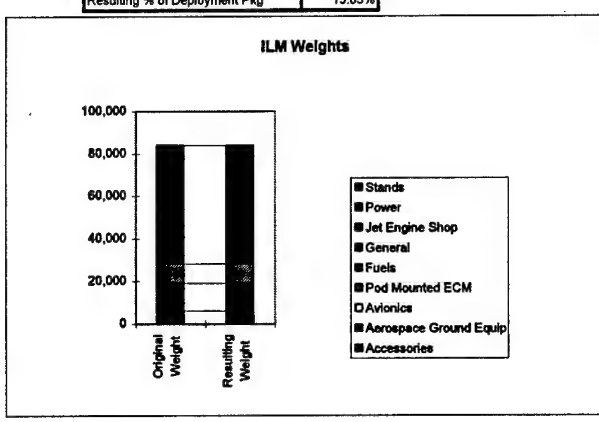
Weight Model: Sheet 4 of 10



Weight Model: Sheet 5 of 10

Intermediate Lev. Maint	
Original weight	83934.9916
Original % of Deployment Pkg	15.63%
Resulting Weight	83934.9916
% of Decrease (Increase) Weight	0.00%
Resulting % of Deployment Pkg	15.63%

Intermediate Lev. Maint
Original weight
Original % of ILM
Resulting Weight
% of Decrease (Increase) Weight
Resulting % of ILM



Weight Model: Sheet 6 of 10

	111,070
	24.52%
	111,070
	0.00%
	24.52%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Air	
Original weight	7,775
Original % of Support Equipment	7.00%
% of Expected Decrease (Increase)	0
Resulting Weight	7,775
Resulting % of Support Equipment	7.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Cooling	
Original weight	12,420
Original % of Support Equipment	11.18%
% of Expected Decrease (Increase)	0
Resulting Weight	12,420
Resulting % of Support Equipment	11.18%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Cryogenics	
Original weight	16,445
Original % of Support Equipment	14.81%
% of Expected Decrease (Increase)	0
Resulting Weight	16,445
Resulting % of Support Equipment	14.81%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE General	
Original weight	10,140
Original % of Support Equipment	9.13%
% of Expected Decrease (Increase)	0
Resulting Weight	10,140
Resulting % of Support Equipment	9.13%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Heat	
Original weight	2,790
Original % of Support Equipment	2.51%
% of Expected Decrease (Increase)	0
Resulting Weight	2,790
Resulting % of Support Equipment	2.51%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Hydraulics	
Original weight	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Jacks	
Original weight	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Lighting	
Original weight	20,760
Original % of Support Equipment	18.69%
% of Expected Decrease (Increase)	0
Resulting Weight	20,760
Resulting % of Support Equipment	18.69%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Lubricants	
Original weight	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐

SE Power	
Original weight	35,365
Original % of Support Equipment	31.84%

F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

% of Expected Decrease (Increase)	0
Resulting Weight	35,365
Resulting % of Support Equipment	31.84%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Stands	
Original weight	3,575
Original % of Support Equipment	3.22%
% of Expected Decrease (Increase)	0
Resulting Weight	3,575
Resulting % of Support Equipment	3.22%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Towbars	
Original weight	1,800
Original % of Support Equipment	1.62%
% of Expected Decrease (Increase)	0
Resulting Weight	1,800
Resulting % of Support Equipment	1.62%

74,299
16.40%
74,299
0.00%
16.40%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

AR General	
Original weight	15,227
Original % of Armaments	20.49%
% of Expected Decrease (Increase)	0
Resulting Weight	15,227
Resulting % of Armaments	20.49%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

AR Jammers	
Original weight	44,180
Original % of Armaments	59.46%
% of Expected Decrease (Increase)	0
Resulting Weight	44,180
Resulting % of Armaments	59.46%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	

AR Missile Racks	
Original weight	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

AR Trailers	
Original weight	14,892
Original % of Armaments	20.04%
% of Expected Decrease (Increase)	0
Resulting Weight	14,892
Resulting % of Armaments	20.04%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	☐
F-117	

AR Universal Ammunition Loader	
Original weight	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐

TE Avionics	
Original weight	0
Original % of Test Equipment	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0

Weight Model: Sheet 8 of 10

A-10	
F-117	☐

Resulting % of Test Equipment	0.00%

63,012
13.91%
63,012
0.00%
13.91%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE General	
Original weight	3,240
Original % of Test Equipment	5.14%
% of Expected Decrease (Increase)	0
Resulting Weight	3,240
Resulting % of Test Equipment	5.14%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE Hydraulics	
Original weight	12,300
Original % of Test Equipment	19.52%
% of Expected Decrease (Increase)	0
Resulting Weight	12,300
Resulting % of Test Equipment	19.52%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

TE Pod Mounted Sensors	
Original weight	47,472
Original % of Test Equipment	75.34%
% of Expected Decrease (Increase)	0
Resulting Weight	47,472
Resulting % of Test Equipment	75.34%

77,137
17.03%
77,137
0.00%
17.03%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Engines	
Original weight	19,846
Original % of Spares	25.73%
% of Expected Decrease (Increase)	0
Resulting Weight	19,846
Resulting % of Spares	25.73%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Readiness Spares Package	
Original weight	52,442
Original % of Spares	67.99%
% of Expected Decrease (Increase)	0
Resulting Weight	52,442
Resulting % of Spares	67.99%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Tires	
Original weight	969
Original % of Spares	1.26%
% of Expected Decrease (Increase)	0
Resulting Weight	969
Resulting % of Spares	1.26%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

SP Drop Tanks	
Original weight	3,880
Original % of Spares	5.03%
% of Expected Decrease (Increase)	0
Resulting Weight	3,880
Resulting % of Spares	5.03%

116,290
25.67%
116,290
0.00%
25.67%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

FS Flightline Support	
Original weight	116,290
Original % of Specialists	100.00%
% of Expected Decrease (Increase)	0
Resulting Weight	116,290
Resulting % of Specialists	100.00%

Weight Model: Sheet 9 of 10

0	
0.00%	
0	
#DIV/0!	
0.00%	

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aerospace Ground Equipment	
Original weight	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	☐

VE General	
Original weight	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aircraft Towing	
Original weight	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Specialists	0.00%

11,260	
2.49%	
11,260	
0.00%	
2.49%	

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Administration	
Original weight	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Classified & Intel	
Original weight	9,802
Original % of Operations	87.05%
% of Expected Decrease (Increase)	0
Resulting Weight	9,802
Resulting % of Operations	87.05%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

OP General	
Original weight	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Life Support	
Original weight	1,458
Original % of Operations	12.95%
% of Expected Decrease (Increase)	0
Resulting Weight	1,458
Resulting % of Operations	12.95%

Weight Model: Sheet 10 of 10

83,935
100.00%
83,935
0.00%
100.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

IL Accessories	
Original weight	6,358
Original % of ILM	7.57%
% of Expected Decrease (Increase)	0
Resulting Weight	6,358
Resulting % of ILM	7.57%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Aerospace Ground Equipment	
Original weight	12,859
Original % of ILM	15.32%
% of Expected Decrease (Increase)	0
Resulting Weight	12,859
Resulting % of ILM	15.32%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	☐

IL Avionics	
Original weight	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	
A-10	☐
F-117	

IL Pod Mounted ECM	
Original weight	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Fuels	
Original weight	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

IL General	
Original weight	9,030
Original % of ILM	10.76%
% of Expected Decrease (Increase)	0
Resulting Weight	9,030
Resulting % of ILM	10.76%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

IL Jet Engine Shop	
Original weight	55,688
Original % of ILM	66.35%
% of Expected Decrease (Increase)	0
Resulting Weight	55,688
Resulting % of ILM	66.35%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	☐

IL Power	
Original weight	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of ILM	0.00%

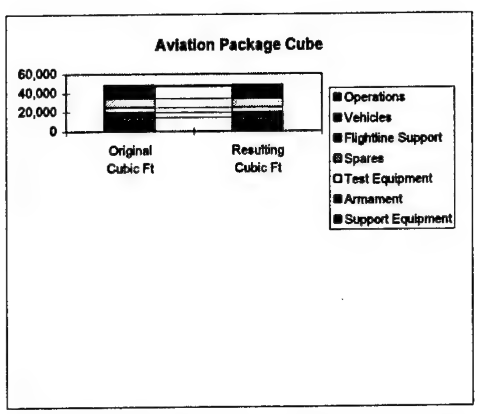
Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Stands	
Original weight	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	0
Resulting Weight	0
Resulting % of ILM	0.00%

Cube Model: Sheet 1 of 10

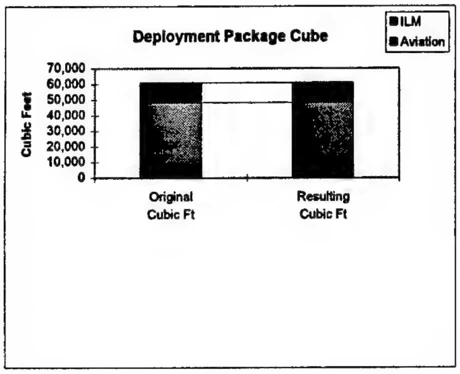
Support Equipment
Original Cube
Original % of Aviation
Resulting Cube
% of Decrease (Increase) Cube
Resulting % of Aviation

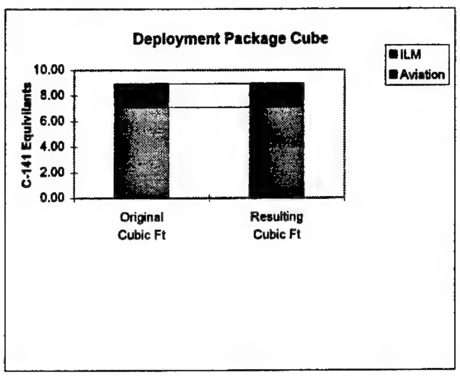
Armament	
Original Cube	
Original % of Aviation	
Resulting Cube	
% of Decrease (Increase) Cube	
Resulting % of Aviation	



Aviation	
Original weight	48,421
Original % of Deployment Pkg	79.35%
Resulting Cube	48,421
% of Decrease (Increase) Cube	0.00%
Resulting % of Deployment Pkg	79.35%

Cube Model: Sheet 3 of 10





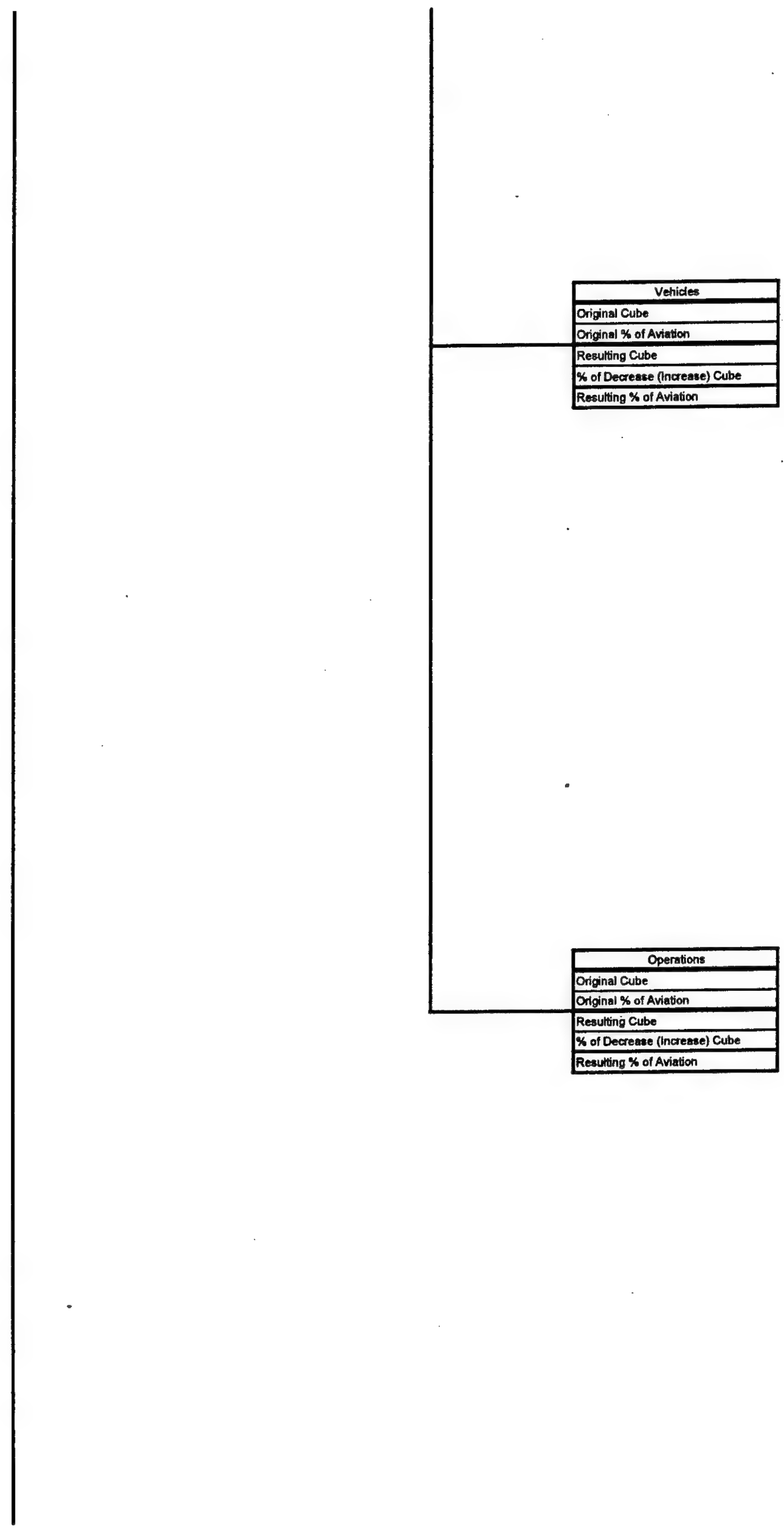
Original Cube	61021.99
Resulting Cube	61021.99
% of Decrease (Increase) Cube	0.00%

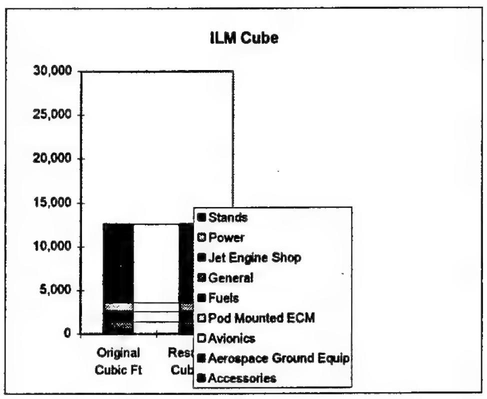
Test Equipment
Original Cube
Original % of Aviation
Resulting Cube
% of Decrease (Increase) Cube
Resulting % of Aviation

Spares
Original Cube
Original % of Aviation
Resulting Cube
% of Decrease (Increase) Cube
Resulting % of Aviation

Flightline Support
Original Cube
Original % of Aviation
Resulting Cube
% of Decrease (Increase) Cube
Resulting % of Aviation

Cube Model: Sheet 4 of 10





Intermediate Lev. Maint	
Original weight	12600.9987
Original % of Deployment Pkg	20.65%
Resulting Weight	12600.9987
% of Decrease (Increase) Cube	0.00%
Resulting % of Deployment Pkg	20.65%

Intermediate Lev. Maint
Original Cube
Original % of ILM
Resulting Cube
% of Decrease (Increase) Cube
Resulting % of ILM

Cube Model: Sheet 6 of 10

	14,672
	30.30%
	14,672
	0.00%
	30.30%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Air	
Original Cube	1,051
Original % of Support Equipment	7.16%
% of Expected Decrease (Increase)	
Resulting Cube	1,051
Resulting % of Support Equipment	7.16%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Cooling	
Original Cube	2,763
Original % of Support Equipment	18.83%
% of Expected Decrease (Increase)	
Resulting Cube	2,763
Resulting % of Support Equipment	18.83%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Cryogenics	
Original Cube	1,342
Original % of Support Equipment	9.15%
% of Expected Decrease (Increase)	
Resulting Cube	1,342
Resulting % of Support Equipment	9.15%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE General	
Original Cube	1,014
Original % of Support Equipment	6.91%
% of Expected Decrease (Increase)	
Resulting Cube	1,014
Resulting % of Support Equipment	6.91%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Heat	
Original Cube	435
Original % of Support Equipment	2.96%
% of Expected Decrease (Increase)	
Resulting Cube	435
Resulting % of Support Equipment	2.96%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Hydraulics	
Original Cube	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Jacks	
Original Cube	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Lighting	
Original Cube	2,565
Original % of Support Equipment	17.48%
% of Expected Decrease (Increase)	
Resulting Cube	2,565
Resulting % of Support Equipment	17.48%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Lubricants	
Original Cube	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐

SE Power	
Original Cube	3,239
Original % of Support Equipment	22.08%

Cube Model: Sheet 7 of 10

F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

% of Expected Decrease (Increase)	
Resulting Cube	3,239
Resulting % of Support Equipment	22.08%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Stands	
Original Cube	1,306
Original % of Support Equipment	8.90%
% of Expected Decrease (Increase)	
Resulting Cube	1,306
Resulting % of Support Equipment	8.90%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Towbars	
Original Cube	957
Original % of Support Equipment	6.52%
% of Expected Decrease (Increase)	
Resulting Cube	957
Resulting % of Support Equipment	6.52%

5,164
10.66%
5,164
0.00%
10.66%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

AR General	
Original Cube	1,233
Original % of Armaments	23.88%
% of Expected Decrease (Increase)	
Resulting Cube	1,233
Resulting % of Armaments	23.88%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

AR Jammers	
Original Cube	2,146
Original % of Armaments	41.56%
% of Expected Decrease (Increase)	
Resulting Cube	2,146
Resulting % of Armaments	41.56%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	

AR Missile Racks	
Original Cube	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

AR Trailers	
Original Cube	1,785
Original % of Armaments	34.57%
% of Expected Decrease (Increase)	
Resulting Cube	1,785
Resulting % of Armaments	34.57%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	☐
F-117	

AR Universal Ammunition Loader	
Original Cube	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐

TE Avionics	
Original Cube	0
Original % of Test Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0

A-10	☐
F-117	☐

Resulting % of Test Equipment	0.00%

4,953
10.23%
4,953
0.00%
10.23%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE General	
Original Cube	208
Original % of Test Equipment	4.20%
% of Expected Decrease (Increase)	
Resulting Cube	208
Resulting % of Test Equipment	4.20%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE Hydraulics	
Original Cube	948
Original % of Test Equipment	19.14%
% of Expected Decrease (Increase)	
Resulting Cube	948
Resulting % of Test Equipment	19.14%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

TE Pod Mounted Sensors	
Original Cube	3,797
Original % of Test Equipment	76.66%
% of Expected Decrease (Increase)	
Resulting Cube	3,797
Resulting % of Test Equipment	76.66%

9,557
19.74%
9,557
0.00%
19.74%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Engines	
Original Cube	2,309
Original % of Spares	24.16%
% of Expected Decrease (Increase)	
Resulting Cube	2,309
Resulting % of Spares	24.16%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Readiness Spares Package	
Original Cube	6,134
Original % of Spares	64.18%
% of Expected Decrease (Increase)	
Resulting Cube	6,134
Resulting % of Spares	64.18%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Tires	
Original Cube	114
Original % of Spares	1.19%
% of Expected Decrease (Increase)	
Resulting Cube	114
Resulting % of Spares	1.19%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

SP Drop Tanks	
Original Cube	1,000
Original % of Spares	10.46%
% of Expected Decrease (Increase)	
Resulting Cube	1,000
Resulting % of Spares	10.46%

12,705
26.24%
12,705
0.00%
26.24%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

FS Flightline Support	
Original Cube	12,705
Original % of Specialists	100.00%
% of Expected Decrease (Increase)	
Resulting Cube	12,705
Resulting % of Specialists	100.00%

Cube Model: Sheet 9 of 10

0
0.00%
0
#DIV/0!
0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aerospace Ground Equipment	
Original Cube	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	☐

VE General	
Original Cube	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aircraft Towing	
Original Cube	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Specialists	0.00%

1,370
2.83%
1,370
0.00%
2.83%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Administration	
Original Cube	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Classified & Intel	
Original Cube	908
Original % of Operations	66.28%
% of Expected Decrease (Increase)	
Resulting Cube	908
Resulting % of Operations	66.28%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

OP General	
Original Cube	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Life Support	
Original Cube	462
Original % of Operations	33.72%
% of Expected Decrease (Increase)	
Resulting Cube	462
Resulting % of Operations	33.72%

Cube Model: Sheet 10 of 10

12,601
100.00%
12,601
0.00%
100.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

IL Accessories	
Original Cube	1,393
Original % of ILM	11.05%
% of Expected Decrease (Increase)	
Resulting Cube	1,393
Resulting % of ILM	11.05%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Aerospace Ground Equipment	
Original Cube	1,168
Original % of ILM	9.27%
% of Expected Decrease (Increase)	
Resulting Cube	1,168
Resulting % of ILM	9.27%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	☐

IL Avionics	
Original Cube	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	
A-10	☐
F-117	

IL Pod Mounted ECM	
Original Cube	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Fuels	
Original Cube	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

IL General	
Original Cube	1,024
Original % of ILM	8.13%
% of Expected Decrease (Increase)	
Resulting Cube	1,024
Resulting % of ILM	8.13%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

IL Jet Engine Shop	
Original Cube	9,016
Original % of ILM	71.55%
% of Expected Decrease (Increase)	
Resulting Cube	9,016
Resulting % of ILM	71.55%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	☐

IL Power	
Original Cube	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of ILM	0.00%

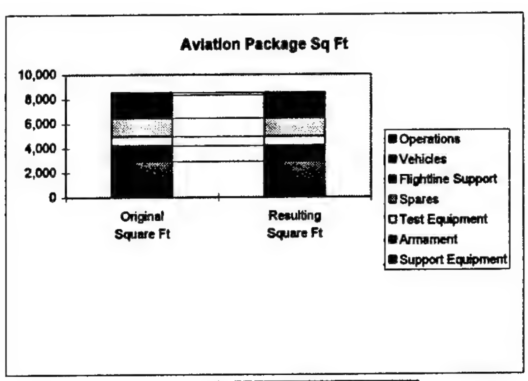
Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Stands	
Original Cube	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Cube	0
Resulting % of ILM	0.00%

Sq Ft Model: Sheet 1 of 10

Support Equipment
Original Square Footage
Original % of Aviation
Resulting Square Footage
% of Decrease (Increase) Sq Ft
Resulting % of Aviation

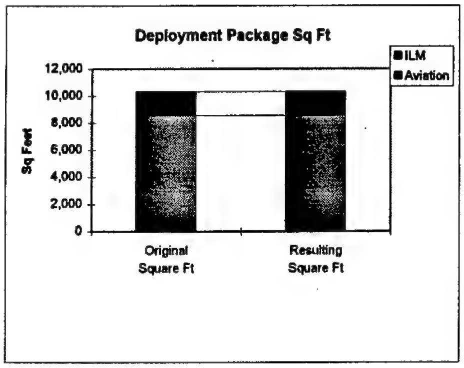
Armament	
Original Square Footage	
Original % of Aviation	
Resulting Square Footage	
% of Decrease (Increase) Sq Ft	
Resulting % of Aviation	

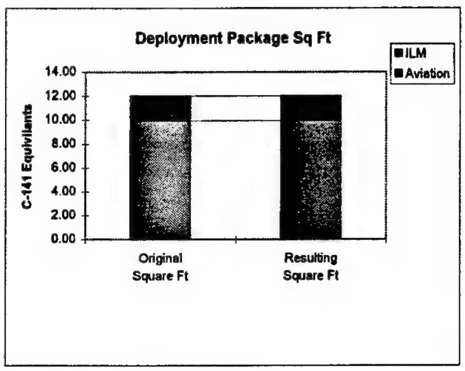


Aviation	
Original Square Footage	8,554
Original % of Deployment Pkg	82.90%
Resulting Square Footage	8,554
% of Decrease (Increase) Sq Ft	0.00%
Resulting % of Deployment Pkg	82.90%

Sq Ft Model: Sheet 3 of 10

Test Equipment	
Original Square Footage	
Original % of Aviation	
Resulting Square Footage	
% of Decrease (Increase) Sq Ft	
Resulting % of Aviation	





Original Square Footage	10318.23
Resulting Square Footage	10318.23
% of Decrease (Increase) Sq Ft	0.00%

Spares	
Original Square Footage	
Original % of Aviation	
Resulting Square Footage	
% of Decrease (Increase) Sq Ft	
Resulting % of Aviation	

Flightline Support	
Original Square Footage	
Original % of Aviation	
Resulting Square Footage	
% of Decrease (Increase) Sq Ft	
Resulting % of Aviation	

Sq Ft Model: Sheet 4 of 10

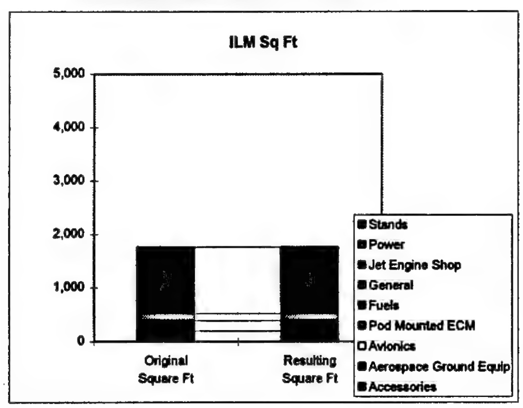
Vehicles
Original Square Footage
Original % of Aviation
Resulting Square Footage
% of Decrease (Increase) Sq Ft
Resulting % of Aviation

Operations
Original Square Footage
Original % of Aviation
Resulting Square Footage
% of Decrease (Increase) Sq Ft
Resulting % of Aviation

Sq Ft Model: Sheet 5 of 10

Intermediate Lev. Maint	
Original Square Footage	1764.1526
Original % of Deployment Pkg	17.10%
Resulting Square Footage	1764.1526
% of Decrease (Increase) Sq Ft	0.00%
Resulting % of Deployment Pkg	17.10%

Intermediate Lev. Maint
Original Square Footage
Original % of ILM
Resulting Square Footage
% of Decrease (Increase) Sq Ft
Resulting % of ILM



Sq Ft Model: Sheet 6 of 10

	2,943
	34.41%
	2,943
	0.00%
	34.41%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Air	
Original Square Footage	244
Original % of Support Equipment	8.28%
% of Expected Decrease (Increase)	
Resulting Square Footage	244
Resulting % of Support Equipment	8.28%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Cooling	
Original Square Footage	479
Original % of Support Equipment	16.28%
% of Expected Decrease (Increase)	
Resulting Square Footage	479
Resulting % of Support Equipment	16.28%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Cryogenics	
Original Square Footage	299
Original % of Support Equipment	10.16%
% of Expected Decrease (Increase)	
Resulting Square Footage	299
Resulting % of Support Equipment	10.16%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE General	
Original Square Footage	245
Original % of Support Equipment	8.31%
% of Expected Decrease (Increase)	
Resulting Square Footage	245
Resulting % of Support Equipment	8.31%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Heat	
Original Square Footage	110
Original % of Support Equipment	3.75%
% of Expected Decrease (Increase)	
Resulting Square Footage	110
Resulting % of Support Equipment	3.75%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Hydraulics	
Original Square Footage	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Jacks	
Original Square Footage	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Lighting	
Original Square Footage	459
Original % of Support Equipment	15.60%
% of Expected Decrease (Increase)	
Resulting Square Footage	459
Resulting % of Support Equipment	15.60%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

SE Lubricants	
Original Square Footage	0
Original % of Support Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Support Equipment	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐

SE Power	
Original Square Footage	539
Original % of Support Equipment	18.33%

Sq Ft Model: Sheet 7 of 10

Data Inclusion Selection Box	Select
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

% of Expected Decrease (Increase)	
Resulting Square Footage	539
Resulting % of Support Equipment	18.33%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Stands	
Original Square Footage	208
Original % of Support Equipment	7.08%
% of Expected Decrease (Increase)	
Resulting Square Footage	208
Resulting % of Support Equipment	7.08%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SE Towbars	
Original Square Footage	359
Original % of Support Equipment	12.19%
% of Expected Decrease (Increase)	
Resulting Square Footage	359
Resulting % of Support Equipment	12.19%

1,268
14.82%
1,268
0.00%
14.82%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

AR General	
Original Square Footage	198
Original % of Armaments	15.62%
% of Expected Decrease (Increase)	
Resulting Square Footage	198
Resulting % of Armaments	15.62%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

AR Jammers	
Original Square Footage	611
Original % of Armaments	48.23%
% of Expected Decrease (Increase)	
Resulting Square Footage	611
Resulting % of Armaments	48.23%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	

AR Missile Racks	
Original Square Footage	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

AR Trailers	
Original Square Footage	458
Original % of Armaments	36.15%
% of Expected Decrease (Increase)	
Resulting Square Footage	458
Resulting % of Armaments	36.15%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	☐
F-117	

AR Universal Ammunition Loader	
Original Square Footage	0
Original % of Armaments	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Armaments	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐

TE Avionics	
Original Square Footage	0
Original % of Test Equipment	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0

Sq Ft Model: Sheet 8 of 10

A-10	
F-117	☐

Resulting % of Test Equipment	0.00%

738	
8.63%	
738	
0.00%	
8.63%	

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE General	
Original Square Footage	44
Original % of Test Equipment	5.93%
% of Expected Decrease (Increase)	
Resulting Square Footage	44
Resulting % of Test Equipment	5.93%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

TE Hydraulics	
Original Square Footage	144
Original % of Test Equipment	19.51%
% of Expected Decrease (Increase)	
Resulting Square Footage	144
Resulting % of Test Equipment	19.51%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

TE Pod Mounted Sensors	
Original Square Footage	550
Original % of Test Equipment	74.56%
% of Expected Decrease (Increase)	
Resulting Square Footage	550
Resulting % of Test Equipment	74.56%

1,525	
17.82%	
1,525	
0.00%	
17.82%	

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Engines	
Original Square Footage	328
Original % of Spares	21.52%
% of Expected Decrease (Increase)	
Resulting Square Footage	328
Resulting % of Spares	21.52%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Readiness Spares Package	
Original Square Footage	916
Original % of Spares	60.07%
% of Expected Decrease (Increase)	
Resulting Square Footage	916
Resulting % of Spares	60.07%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

SP Tires	
Original Square Footage	37
Original % of Spares	2.41%
% of Expected Decrease (Increase)	
Resulting Square Footage	37
Resulting % of Spares	2.41%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

SP Drop Tanks	
Original Square Footage	244
Original % of Spares	16.01%
% of Expected Decrease (Increase)	
Resulting Square Footage	244
Resulting % of Spares	16.01%

1,883	
22.01%	
1,883	
0.00%	
22.01%	

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

FS Flightline Support	
Original Square Footage	1,883
Original % of Specialists	100.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	1,883
Resulting % of Specialists	100.00%

0
0.00%
0
#DIV/0!
0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aerospace Ground Equipment	
Original Square Footage	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	☐

VE General	
Original Square Footage	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Specialists	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

VE Aircraft Towing	
Original Square Footage	0
Original % of Specialists	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Specialists	0.00%

198
2.31%
198
0.00%
2.31%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Administration	
Original Square Footage	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Classified & Intel	
Original Square Footage	132
Original % of Operations	66.67%
% of Expected Decrease (Increase)	
Resulting Square Footage	132
Resulting % of Operations	66.67%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	☐
F-15E	☐
A-10	
F-117	☐

OP General	
Original Square Footage	0
Original % of Operations	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of Operations	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	☐

OP Life Support	
Original Square Footage	66
Original % of Operations	33.33%
% of Expected Decrease (Increase)	
Resulting Square Footage	66
Resulting % of Operations	33.33%

Sq Ft Model: Sheet 10 of 10

1,764
100.00%
1,764
0.00%
100.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	

IL Accessories	
Original Square Footage	198
Original % of ILM	11.22%
% of Expected Decrease (Increase)	
Resulting Square Footage	198
Resulting % of ILM	11.22%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Aerospace Ground Equipment	
Original Square Footage	193
Original % of ILM	10.97%
% of Expected Decrease (Increase)	
Resulting Square Footage	193
Resulting % of ILM	10.97%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	☐
F-117	☐

IL Avionics	
Original Square Footage	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	
A-10	☐
F-117	

IL Pod Mounted ECM	
Original Square Footage	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Fuels	
Original Square Footage	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of ILM	0.00%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	☐
F-117	

IL General	
Original Square Footage	132
Original % of ILM	7.48%
% of Expected Decrease (Increase)	
Resulting Square Footage	132
Resulting % of ILM	7.48%

Data Inclusion Selection Box	Select
F-16 LANTIRN	☒
F-16 HARM	☐
F-16 C/D	☐
F-15E	☐
A-10	
F-117	

IL Jet Engine Shop	
Original Square Footage	1,241
Original % of ILM	70.33%
% of Expected Decrease (Increase)	
Resulting Square Footage	1,241
Resulting % of ILM	70.33%

Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	
F-16 C/D	
F-15E	☐
A-10	
F-117	☐

IL Power	
Original Square Footage	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of ILM	0.00%

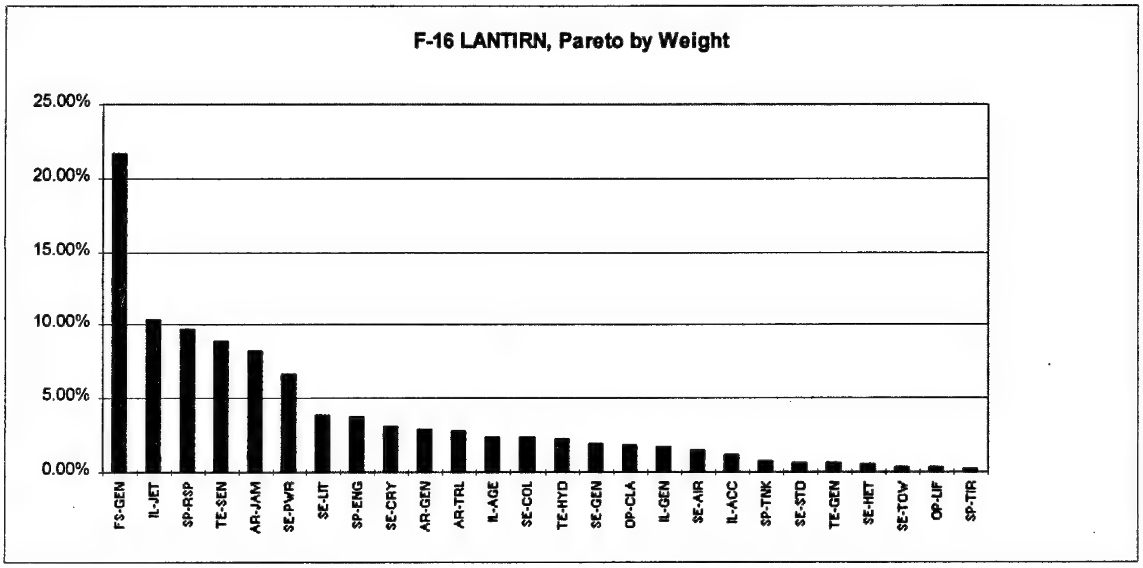
Data Inclusion Selection Box	Select
F-16 LANTIRN	
F-16 HARM	☐
F-16 C/D	☐
F-15E	
A-10	
F-117	

IL Stands	
Original Square Footage	0
Original % of ILM	0.00%
% of Expected Decrease (Increase)	
Resulting Square Footage	0
Resulting % of ILM	0.00%

Appendix K -- Data Analysis, F-16 LANTIRN

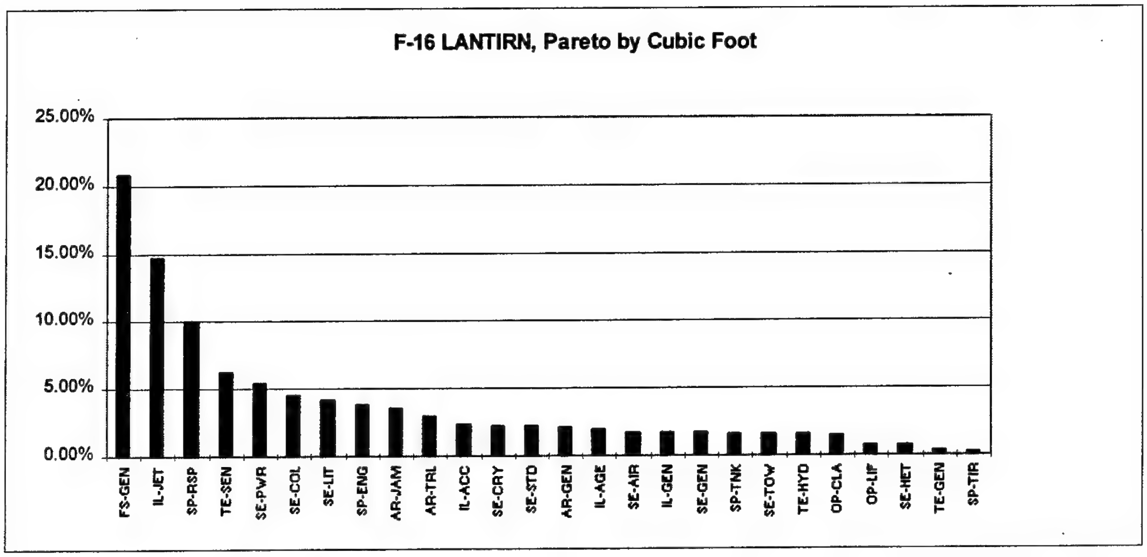
F-16, Block 40 LANTIRN by Weight, Cubic Foot, and Square Foot

The following categories had no values:
AR-RAK, AR-UAL, OP-ADM, OP-GEN, TE-HYD, SE-JAK, SE-LUB, TE-AVI, VE-AGE, VE-GEN, VE-TOW, IL-AVI, IL-ECM, IL-FUL, IL-PWR, IL-STD



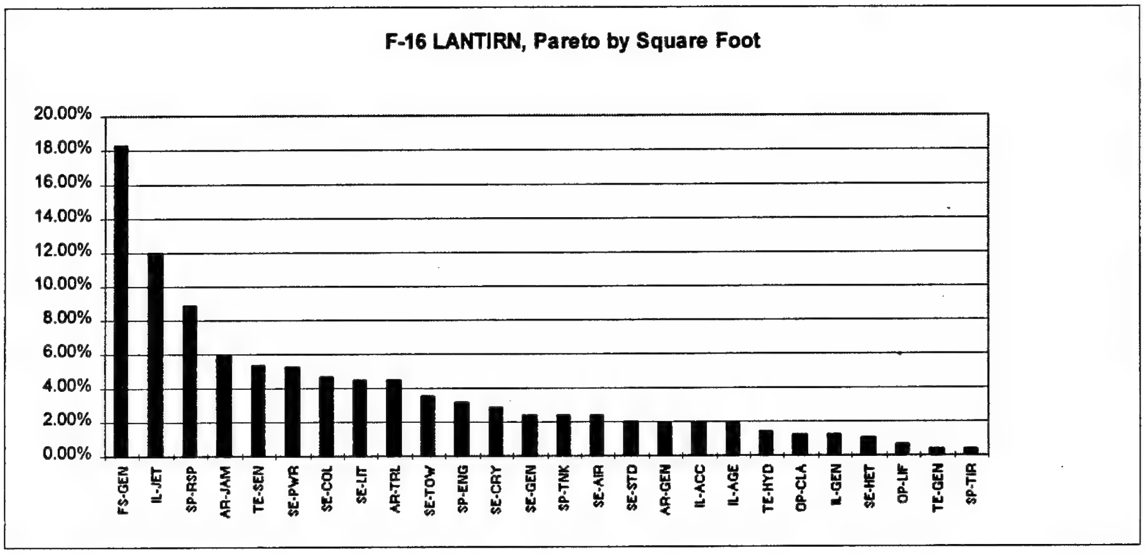
Category	Weight	Percent of Total Package
FS-GEN	116,290	21.66%
IL-JET	55,688	10.37%
SP-RSP	52,442	9.77%
TE-SEN	47,472	8.84%
AR-JAM	44,180	8.23%
SE-PWR	35,365	6.59%
SE-LIT	20,760	3.87%
SP-ENG	19,846	3.70%
SE-CRY	16,445	3.06%
AR-GEN	15,227	2.84%
AR-TRL	14,892	2.77%
IL-AGE	12,859	2.39%
SE-COL	12,420	2.31%
TE-HYD	12,300	2.29%
SE-GEN	10,140	1.89%
OP-CLA	9,802	1.83%
IL-GEN	9,030	1.68%
SE-AIR	7,775	1.45%
IL-ACC	6,358	1.18%
SP-TNK	3,880	0.72%
SE-STD	3,575	0.67%
TE-GEN	3,240	0.60%
SE-HET	2,790	0.52%
SE-TOW	1,800	0.34%
OP-LIF	1,458	0.27%
SP-TIR	969	0.18%

Total Weight: 537,003 pounds



Category	Cubic Feet	Percent of Total Package
FS-GEN	12,705	20.82%
IL-JET	9,016	14.77%
SP-RSP	6,134	10.05%
TE-SEN	3,797	6.22%
SE-PWR	3,239	5.31%
SE-COL	2,763	4.53%
SE-LIT	2,565	4.20%
SP-ENG	2,309	3.78%
AR-JAM	2,146	3.52%
AR-TRL	1,785	2.93%
IL-ACC	1,393	2.28%
SE-CRY	1,342	2.20%
SE-STD	1,306	2.14%
AR-GEN	1,233	2.02%
IL-AGE	1,168	1.91%
SE-AIR	1,051	1.72%
IL-GEN	1,024	1.68%
SE-GEN	1,014	1.66%
SP-TNK	1,000	1.64%
SE-TOW	957	1.57%
TE-HYD	948	1.55%
OP-CLA	908	1.49%
OP-LIF	462	0.76%
SE-HET	435	0.71%
TE-GEN	208	0.34%
SP-TIR	114	0.19%

Total Cubic Foot: 61,022



Category	Square Feet	Percent of Total Package
FS-GEN	1,883	18.25%
IL-JET	1,241	12.02%
SP-RSP	916	8.87%
AR-JAM	611	5.93%
TE-SEN	550	5.33%
SE-PWR	539	5.23%
SE-COL	479	4.64%
SE-LIT	459	4.45%
AR-TRL	458	4.44%
SE-TOW	359	3.48%
SP-ENG	328	3.18%
SE-CRY	299	2.90%
SE-GEN	245	2.37%
SP-TNK	244	2.37%
SE-AIR	244	2.36%
SE-STD	208	2.02%
AR-GEN	198	1.92%
IL-ACC	198	1.92%
IL-AGE	193	1.88%
TE-HYD	144	1.40%
OP-CLA	132	1.28%
IL-GEN	132	1.28%
SE-HET	110	1.07%
OP-LIF	66	0.64%
TE-GEN	44	0.42%
SP-TIR	37	0.36%

Total Square Foot: 10,318 Square Feet

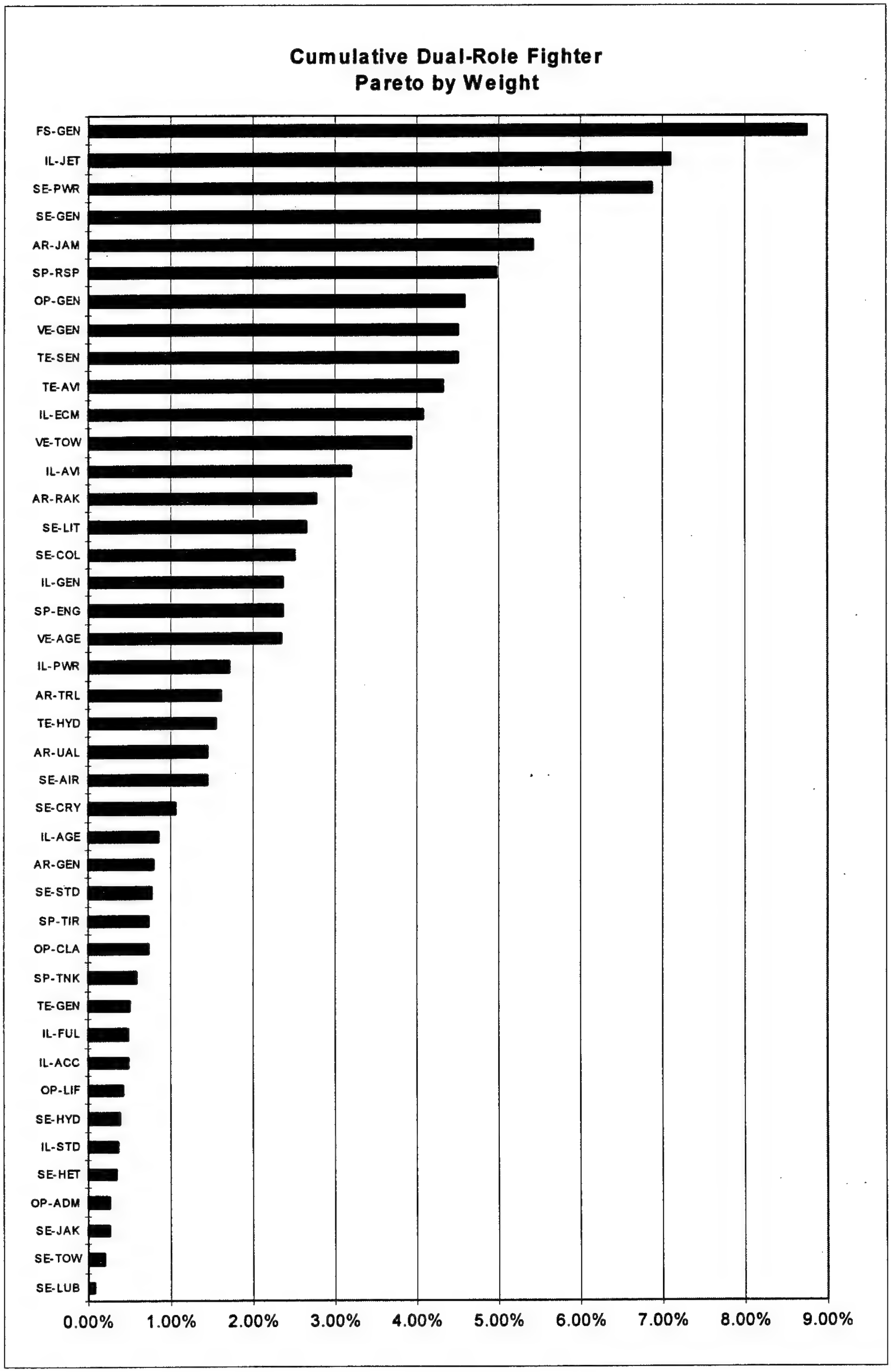
Appendix L -- Data Analysis, Cumulative Dual-Role Fighter

Cumulative Dual-Role Fighter Aircraft by Weight, Cubic Foot, and Square Foot

The cumulative models combine each category which is used by any of the six selected weapon systems. Each system does NOT use every category so the following data is inflated beyond the values for a select system. This information is provided to emphasize the relative contribution of each category in relation to weight, cubic foot, and square foot.

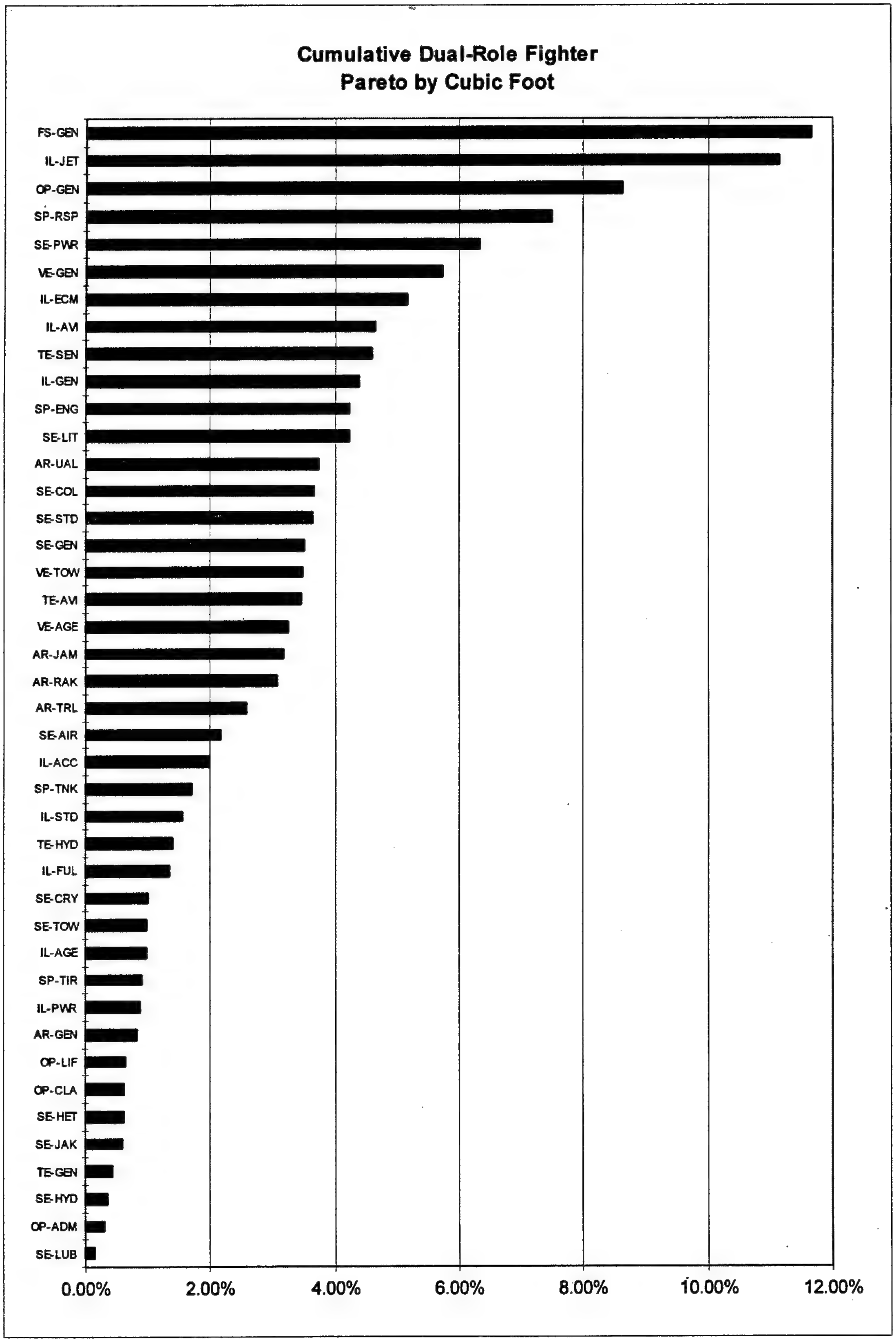
Data, by Weight (pounds)

Category	Weight	Percent of Total Package
FS-GEN	71,739	8.76%
IL-JET	58,192	7.10%
SE-PWR	56,339	6.88%
SE-GEN	45,067	5.50%
AR-JAM	44,527	5.43%
SP-RSP	40,723	4.97%
OP-GEN	37,664	4.60%
TE-SEN	36,954	4.51%
VE-GEN	36,957	4.51%
TE-AVI	35,519	4.33%
IL-ECM	33,500	4.09%
VE-TOW	32,202	3.93%
IL-AVI	26,249	3.20%
AR-RAK	22,790	2.78%
SE-LIT	21,759	2.66%
SE-COL	20,648	2.52%
SP-ENG	19,331	2.36%
IL-GEN	19,377	2.36%
VE-AGE	19,234	2.35%
IL-PWR	14,060	1.72%
AR-TRL	13,285	1.62%
TE-HYD	12,783	1.56%
AR-UAL	11,876	1.45%
SE-AIR	11,796	1.44%
SE-CRY	8,766	1.07%
IL-AGE	7,080	0.86%
AR-GEN	6,495	0.79%
SE-STD	6,276	0.77%
SP-TIR	6,067	0.74%
OP-CLA	5,975	0.73%
SP-TNK	4,890	0.60%
TE-GEN	4,241	0.52%
IL-ACC	3,939	0.48%
IL-FUL	3,950	0.48%
OP-LIF	3,575	0.44%
SE-HYD	3,117	0.38%
IL-STD	3,024	0.37%
SE-HET	2,912	0.36%
SE-JAK	2,098	0.26%
OP-ADM	2,119	0.26%
SE-TOW	1,642	0.20%
SE-LUB	645	0.08%


Cumulative Dual-Role Fighter
Pareto by Weight
FS-GEN
IL-JET
SE-PWR
SE-GEN
AR-JAM
SP-RSP
OP-GEN
VE-GEN
TE-SEN
TE-AVI
IL-ECM
VE-TOW
IL-AVI
AR-RAK
SE-LIT
SE-COL
IL-GEN
SP-ENG
VE-AGE
IL-PWR
AR-TRL
TE-HYD
AR-UAL
SE-AIR
SE-CRY
IL-AGE
AR-GEN
SE-STD
SP-TIR
OP-CLA
SP-TNK
TE-GEN
IL-FUL
IL-ACC
OP-LIF
SE-HYD
IL-STD
SE-HET
OP-ADM
SE-JAK
SE-TOW
SE-LUB
0.00%
1.00%
2.00%
3.00%
4.00%
5.00%
6.00%
7.00%
8.00%
9.00%

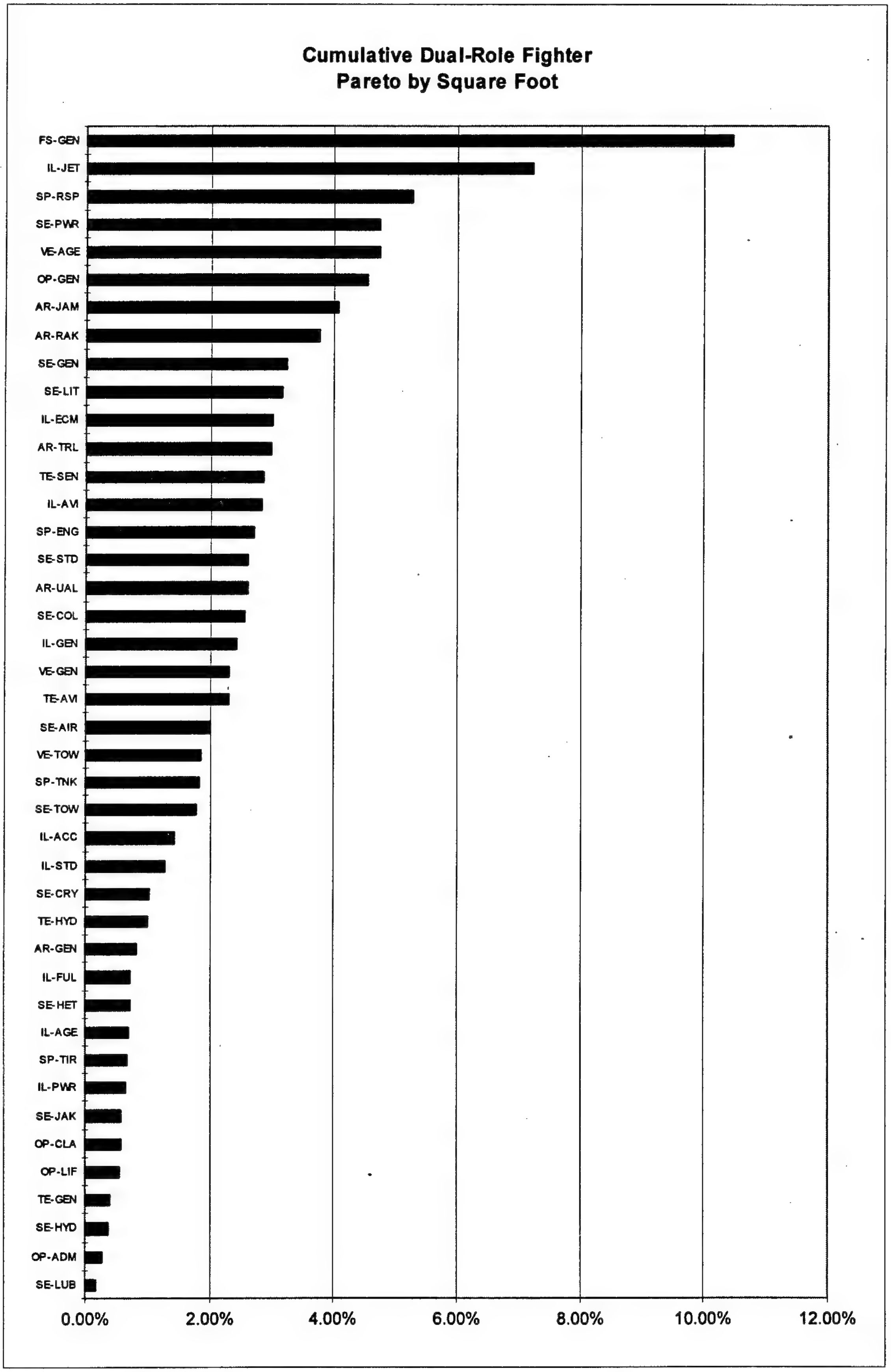
Data, by Cubic Foot

Category	Cubic Feet	Percent of Total Package
FS-GEN	7,856	11.66%
IL-JET	7,514	11.15%
OP-GEN	5,812	8.63%
SP-RSP	5,050	7.49%
SE-PWR	4,269	6.34%
VE-GEN	3,868	5.74%
IL-ECM	3,482	5.17%
IL-AVI	3,139	4.66%
TE-SEN	3,101	4.60%
IL-GEN	2,967	4.40%
SP-ENG	2,858	4.24%
SE-LIT	2,855	4.24%
AR-UAL	2,523	3.74%
SE-COL	2,468	3.66%
SE-STD	2,462	3.65%
SE-GEN	2,372	3.52%
VE-TOW	2,355	3.49%
TE-AVI	2,342	3.48%
VE-AGE	2,194	3.26%
AR-JAM	2,146	3.18%
AR-RAK	2,067	3.07%
AR-TRL	1,736	2.58%
SE-AIR	1,460	2.17%
IL-ACC	1,343	1.99%
SP-TNK	1,142	1.69%
IL-STD	1,049	1.56%
TE-HYD	946	1.40%
IL-FUL	898	1.33%
SE-CRY	683	1.01%
SE-TOW	669	0.99%
IL-AGE	665	0.99%
SP-TIR	606	0.90%
IL-PWR	598	0.89%
AR-GEN	551	0.82%
OP-LIF	441	0.65%
OP-CLA	423	0.63%
SE-HET	422	0.63%
SE-JAK	393	0.58%
TE-GEN	298	0.44%
SE-HYD	236	0.35%
OP-ADM	209	0.31%
SE-LUB	98	0.15%


Cumulative Dual-Role Fighter
Pareto by Cubic Foot
FS-GEN
IL-JET
OP-GEN
SP-RSP
SE-PWR
VE-GEN
IL-ECM
IL-AVI
TE-SEN
IL-GEN
SP-ENG
SE-LIT
AR-UAL
SE-COL
SE-STD
SE-GEN
VE-TOW
TE-AVI
VE-AGE
AR-JAM
AR-RAK
AR-TRL
SE-AIR
IL-ACC
SP-TNK
IL-STD
TE-HYD
IL-FUL
SE-CRY
SE-TOW
IL-AGE
SP-TIR
IL-PWR
AR-GEN
OP-LIF
OP-CLA
SE-HET
SE-JAK
TE-GEN
SE-HYD
OP-ADM
SE-LUB
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%

Data, by Square Foot

Category	Square Feet	Percent of Total Package
FS-GEN	1,604	10.48%
IL-JET	1,107	7.23%
SP-RSP	809	5.28%
SE-PWR	727	4.75%
VE-AGE	726	4.74%
OP-GEN	696	4.55%
AR-JAM	621	4.06%
AR-RAK	576	3.76%
SE-GEN	497	3.25%
SE-LIT	483	3.15%
IL-ECM	462	3.02%
AR-TRL	459	3.00%
TE-SEN	438	2.86%
IL-AVI	436	2.85%
SP-ENG	414	2.70%
SE-STD	399	2.61%
AR-UAL	398	2.60%
SE-COL	392	2.56%
IL-GEN	374	2.44%
VE-GEN	353	2.31%
TE-AVI	352	2.30%
SE-AIR	308	2.01%
VE-TOW	286	1.87%
SP-TNK	282	1.84%
SE-TOW	272	1.78%
IL-ACC	221	1.44%
IL-STD	195	1.27%
SE-CRY	157	1.03%
TE-HYD	152	0.99%
AR-GEN	127	0.83%
SE-HET	112	0.73%
IL-FUL	112	0.73%
IL-AGE	108	0.71%
SP-TIR	102	0.67%
IL-PWR	101	0.66%
SE-JAK	90	0.59%
OP-CLA	88	0.57%
OP-LIF	83	0.54%
TE-GEN	62	0.40%
SE-HYD	58	0.38%
OP-ADM	44	0.29%
SE-LUB	28	0.18%


Cumulative Dual-Role Fighter
Pareto by Square Foot
FS-GEN
IL-JET
SP-RSP
SE-PWR
VE-AGE
OP-GEN
AR-JAM
AR-RAK
SE-GEN
SE-LIT
IL-ECM
AR-TRL
TE-SEN
IL-AVI
SP-ENG
SE-STD
AR-UAL
SE-COL
IL-GEN
VE-GEN
TE-AVI
SE-AIR
VE-TOW
SP-TNK
SE-TOW
IL-ACC
IL-STD
SE-CRY
TE-HYD
AR-GEN
IL-FUL
SE-HET
IL-AGE
SP-TIR
IL-PWR
SE-JAK
OP-CLA
OP-LIF
TE-GEN
SE-HYD
OP-ADM
SE-LUB
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%

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13. ABSTRACT *(Maximum 200 words)*

This research investigated the deployment footprint of a developing dual-role fighter, the Joint Strike Fighter (JSF). This thesis documents the creation of a point estimate linear equation and a spreadsheet model for deployment footprint analysis and provides three example applications of the spreadsheet model for the JSF. The development of the model focused towards direct application in the JSF acquisition process, however, this research also serves as a proof of concept for modeling any future weapon system's deployment footprint. The developed spreadsheet model allows the model manipulator to select a baseline weapon system then alter the various components which make up the overall footprint. The result is a point estimate of the total footprint which can then be used in justification during trade-off studies. The model was developed using Microsoft Excel 5.0 and a synopsis of the model procedures is included. If disk copies of the model are requested from the authors, the package will also include a users manual which is not part of this thesis.

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